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Build:
Guitar practice amp

Car fuel level warning

Hi-Z interface for 60 W amp

Linear-scale ohmeter

Home computers & peripherals –market survey

Great Sound Section:

Multi-track recording at home – Nakamichi cassette deck reviewed

A new dynamic generation of Maxell tapes.

When Maxell announces an improvement in the quality of its tape, you can bet the improvement has to be pretty dynamic. In fact, we think our new generation has even gone beyond our own standards of superior sound reproduction.

Take our high level (CrO_2) position tape — the UD-XL II. Maxell engineers have succeeded in expanding its dynamic range in the middle-low frequency range by 1 dB, while also pushing its sensitivity by 1 dB in the high frequency range. Then look at our normal position UD-XL I, UD and LN tapes — our engineers expanded the dynamic range at all frequency points, while also boosting output in the high frequency range. The new dynamic range, of course, allows for better music reproduction even for LN-type tapes.

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One thing hasn't changed on all Maxell tapes — our functional features like 4-function leader tape, replaceable index labels for UD-XL series tapes and Maxell's through-production system — your guarantee of quality and superior sound reproduction.

Tape selector position UD-XL I, UD, LN: Normal position (Normal bias/120 μsec. EQ)
UD-XL II: High level position (High level bias/70 μsec. EQ)

For details on all Maxell Recording Tape write to
Maxell Advisory Service, P.O. Box 307, North Ryde, N.S.W. 2113

Available time length UD-XL I: 60, 90 min./UD-XL II: 60, 90 min.
UD: 60, 90, 120 min./LN: 60, 90, 120 min.

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QUICK INDEX

FEATURES:

SOUND SECTION:

PROJECT SECTION:

WELL, THERE WENT THE '70s. The last decade saw a whole host of new technologies arise in electronics. Like CMOS, I^2L, microprocessors, VFETs, bubble memories and more. The next decade shows just as much promise – it looks like an exciting time!

In researching this month's lead feature, **Courses and Careers in Electronics,** we were almost engulfed by the enormous diversity of courses offered around the country – at all levels, from trade to professional. Now, diversity in education is undoubtedly a good thing, and certainly all the courses offered would not survive if there were too few students to pay fees, but, we asked – where does the 'product' of those courses end up ? Predominantly, the public service (State and Federal). With little a further enquiry, we found out that most courses, particularly the middle-level (or certificate) courses (which train the bulk of qualified electronics personnel) are geared largely towards producing qualifications to meet public service requirements. Those people who sit on the various standing committees to approve courses and examinations, those in the different State councils for Technical Education, even the State Industrial Training Commissions, appear to have blinkered vision. Relatively few members of these august bodies come from industry, apparently. The whole business seems an incestuous hotchpotch where one bureaucracy is established to perpetuate another.

Industry, it seems, takes the cream of the education institutions' product while 'sneering' at qualifications generally – but perhaps, not without some justification.

Isn't it time industry increased their meagre input to education ? It's in their interest. Isn't it time that the education heirarchy sought more input from industry ?

Do readers have any comments or observations ? We'd like to hear your views.

Roger Harrison, Editor

advertisers

eti ELECTRONICS TODAY INTERNATIONAL

COVER

Chris Masuak of Sydney band The Hitmen, accompanied by Lyn Phillips, tried out our Guitar Practice Amplifier. Our studio was filled with marvellous sounds as Ivy Hansen composed another beautiful cover for you.

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Last June we published a report on the Voyager 1 encounter with the solar system's biggest planet. Voyager 2 had an encounter with Jupiter later in the year — here's the report.

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If you're looking around for a small machine for your business, or you're just an ambitious hobbyist, here's a market guide to available machines.

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Once you've found your system, you're almost certain to need a few peripherals.

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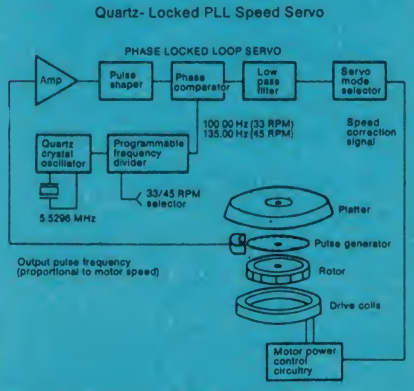
300 W AMPLIFIER MODULE !
You asked for it – here it comes ! A really high power amplifier. This module continues the tradition so firmly established by our long-lived 480 power amp modules.

SERIES 4000 4-WAY LOUDSPEAKER
Continuing our line of quality hi-fi projects, this 4-way speaker system is the 'flagship' of a series of loudspeakers designed by David Tilbrook and developed in our own laboratory.

PIONEER TO SATURN
The spectacular results of Pioneer 11's mission to this fascinating planet are discussed by our European correspondent, Brian Dance.



TURNTABLE TECHNOLOGY
Designers have been paying a lot of attention to the turntable system in recent years and some remarkable technology is appearing as a result.

MORE
"Update you car electronically" proceeds with an over-rev alarm project, plus we have a further project in our low-cost test instrument series . . . not to mention the regular features. An issue not to be missed.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

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READER ENQUIRIES

By Mail: There is no charge for replies but a foolscap-size stamped addressed envelope **must** be enclosed. Queries relating to projects can **only** be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are otherwise than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.

By phone: We can only answer readers technical enquiries by telephone after 4 pm. In enquiring by telephone about back issues or photostats, please ask for the "Subscriptions Department". **33-4282**

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NEWS digest

Australia to get own broadcast satellite

The Australian Government has signalled the go-ahead for the establishment of a domestic broadcast/communications satellite system to cost $250 million.

The announcement was made shortly after our November issue was distributed, which carried the story (p.10) of successful trials with the Canadian Hermes satellite, of satellite telephony and TV broadcasting in Australia.

Tony Staley, Minister for Post and Telecommunications, who announced the approval in Parliament, said the government would be contacting manufacturers for bids and that a temporary satellite project office would be set up under the Department of Posts and Telecommunications.

He said that the government has made no final decision on who will own and control the system, although a working group has recommended that a National Satellite Commission be formed to run the system.

Mr Staley told Parliament there are 40 000 Australians with no prospect of getting telephones and 120 000 with no hope of getting television by the existing ground lines.

"For many Australians, satellite communications offer the only practicable solution to the problems of how to provide any services at all within a reasonable time," he said. "For others, satellite communications hold out the only hope for the improvement of poor services or enabling access to a wider choice of services."

The satellites envisaged will be of a "direct broadcasting" type, able to broadcast radio and television transmissions directly into remote homes, provide two-way telephone links to remote areas and handle conventional communications between towns and cities.

Mr Staley said the first Australian communications satellite was expected to be in orbit by the end of 1984. "We will certainly not be a party to developments which would allow any one broadcasting interest to control television in this country," he added.

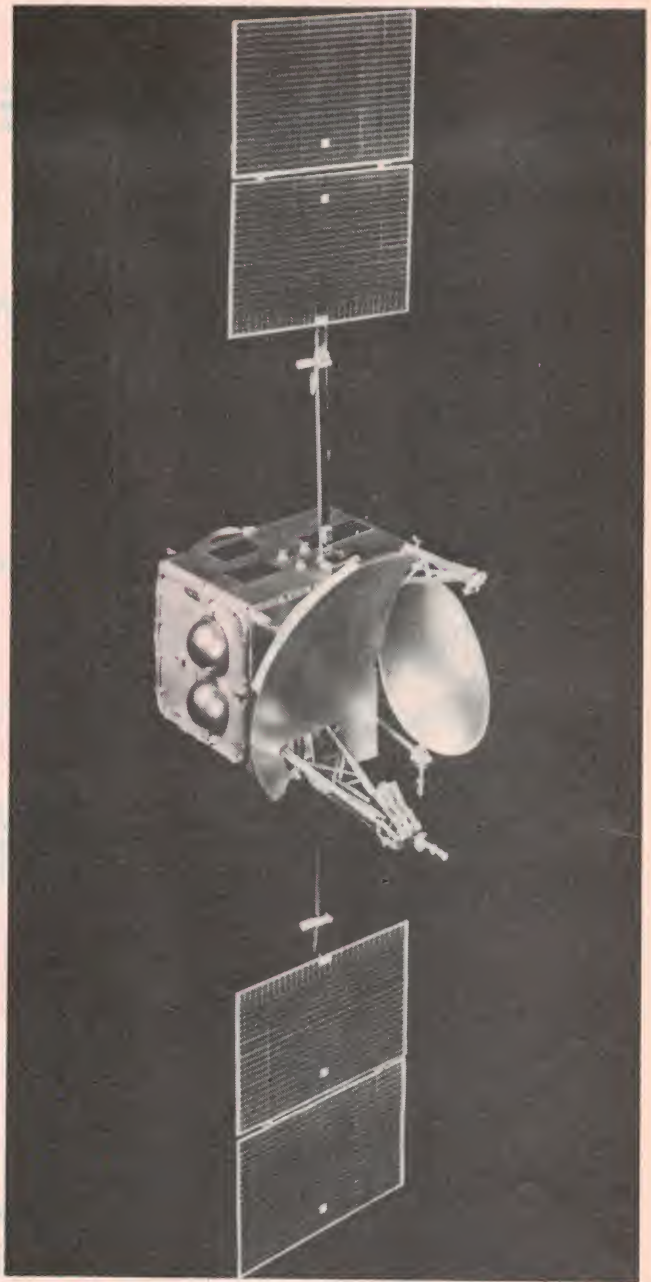
Under the government's tentative plans, three low-powered satellites will be bought. Mr Staley tabled in Parliament the findings of an interdepartmental working group which recommended the use of communications satellites in Australia.

One will be launched into space as an operational communications satellite, the second will be launched as an orbiting "back-up" and the third will remain on the ground as a spare. They will also be used by the Departments of Defence, Health, Education, Science, and Transport.

Mr Staley said the working group and the National Satellite Task Force which reported last year had favored using satellite and had rejected claims that satellites would create unemployment.

Jobs would be created through Australian industry, building satellite ground installations, and the maintenance of the equipment, it noted. The opposition spokesman on Post and Telecommunications, U.E. Innes, warned that under the government's proposals, "the moguls of Australian media control" would benefit from the satellites rather than the general public.

He said that the Labor Party was not opposed to the use of communication satellites, however, he added, the opposition was not convinced by the working group and the task force finds that satellites would not create unemployment.



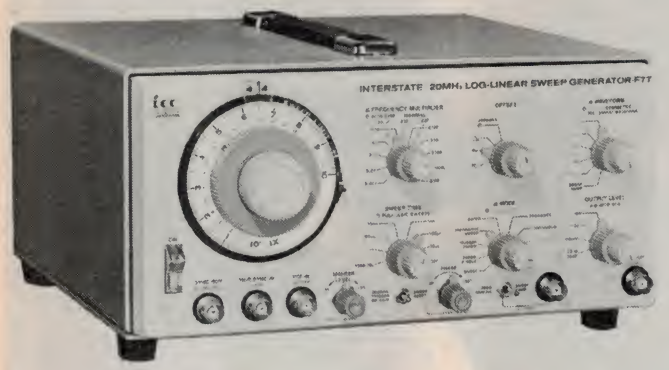
Australia's satellite may be something like this - Canada's Anik B.

Teldor cables available here

The world-renowned Teldor communications cables are now being distributed here by I.F.T.A. Australia.

Types currently available are Telshield 6390698 75 ohm, 6 mm dia., aluminium shield cable for TV, CATV-MATV and FM applications; TVF59, 75 ohm, 6.15 mm dia., available in single-shielded and double-shielded cable, similar to the Telshield, and TVF11 75 ohm, 10.3 mm dia., low-loss cable for TV and communications applications.

Data sheets and further information obtainable from I.F.T.A. Australia, P.O. Box 21, Bondi Beach NSW 2026. (02) 665-8211.



Function generators

The IEC (Series 70) 20 MHz universal signal-source line offers function, pulse and sweep generator capabilities with four models to choose from, all producing sine, square, triangle and dc-level waveforms.

Model F72 and F72 combines the capabilities of "true pulse" and function generators into one versatile unit.

Models F74 and F77 add sweep capabilities to the basic pulse and function generator combination. The top-of-the-line model F77 also offers selectable log/lin sweep, sweep sync, and analogue power amplifier capabilities. For further information, contact Bruce McCarthy at Parameters on (02) 439-3288.

Westinghouse fuel cell development programme

America's Westinghouse Electric Corporation has entered into a cross-licensing agreement with Energy Research Corporation for the development of fuel cells.

Fuel cells produces electricity directly from fossil fuels without the thermal combustion cycle which is a standard part of the electrical generation process. Bypassing direct combustion could raise fuel efficiency 30 to 37 percent in electricity production, and also create excess heat which can be recaptured for other uses.

The fuel cell, combined with a coal gasifier, could produce direct current electricity which would be converted to alternating current and then fed into the utility's electrical grid. This concept would also leave substantial amounts of heat to be recaptured for other purposes, such as industrial processing and/or heating.

Since the fuel cell process would burn cleaner than current coal-fired processes, the base load fuel cell could be located closer to the ultimate consumer, cutting down transmission costs.

The other fuel cell concept involves small fuel cells which resemble batteries where natural gas or naphtha (a petroleum by-product) would be fed through the fuel cell resulting in the generation of electricity and excess heat at user sites. Because this process involves only a small area and is environmentally acceptable, this type of fuel cell could be used on-site to service shopping malls, apartments or industrial parks.

Regulator family can supply 5A

A series of 5A adjustable voltage regulators capable of supplying 10A transient currents for short periods of time is now available from National Semiconductor.

Known as the LM138 series, the new ICs are rated to provide any regulated voltage of 1.2 volts to 33 volts at over 5 amps output current.

Manufactured in a standard three-lead T0-3 transistor package, the LM138 has 0.1 percent load regulation and 0.005 percent per volt line regulation. Two external resistors set the output voltage, making the LM138 much more flexible than fixed output regulators. Also, thermal regulation is guaranteed on the device, with power dissipation of up to 50 watts.

Beryllium Oxide — questions in the house!

Our November issue contained an article on the dangers of Beryllium Oxide, a substance widely found in electronic equipment and components, and in heatsink compounds. Shortly after the issue went on sale the Minister for Health was questioned on the subject. Below is reproduced the extract from Hansard, concerning the question.

DEPARTMENT OF HEALTH
SENATE QUESTION
(Question No. 2095)

SENATOR MASON asked the Minister representing the Minister for Health, upon notice, on 17 October 1979:

(1) Did an article in Electronics Today International, October 1979, claim that paste compounds containing Beryllium Oxide were readily available in both professional and hobby electronics industries without packaging markings to indicate the compound is highly toxic.

(2) Is it intended to inquire into this matter with a view to determining some action to be prescribed.

SENATOR GUILFOYLE — The Minister for Health has provided the following answer to the honourable senator's question:

(1) I am aware that an article "Beryllium — how dangerous?" appeared in "Electronics Today International", October 1979 and that it claims that this toxic substance may have no warning notices or labels attached to it.

(2) The labelling of Beryllium, including every salt, active principle and derivative of Beryllium, has already been considered by the National Health and Medical Research Council. Council's Uniform Poisons Standards recommends that these substances be classified in Schedule 6 and thereby be subject to the following labelling requirement:

"Caution

KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING"

The labelling of poisons or hazardous substances is a matter for the States or Territories and this recommendation has been forwarded to them for appropriate action.

break on through...

The world of professional audio production — live sound and recording, radio, or TV sound — is a very tough business to break into. As in other fields, prospective employers look most favourably on those with aptitude, experience, and formal training.

A solid technical background is, of course, a requirement for audio production work, but the story only starts with the theory; a sound engineer lives by his ears and hands, as well as his mind, and it is only with experience that all three can be coordinated.

The School of Electronics program is designed to provide both the specialised theoretical knowledge and the practical experience necessary to score that production job in radio, TV, or the recording industry. Intensive "hands-on" experience in recording and live sound production, multitrack mixdown, and mastering is included as an essential part of the course, and provides a useful "portfolio" of actual recordings.

The course is conducted part-time over one year, and a certificate is awarded to students who successfully complete all phases of the program.

For details, contact

THE SCHOOL OF ELECTRONICS

64 Alfred St, Milsons Point, Sydney, NSW 2061. Phone (02) 922 6301

Data analyzer has wide applications

The Sony/Tektronix 308 Data Analyzer is the first instrument to combine the capabilities of a state and timing logic analyzer, serial data analyzer and signature analyzer into one compact instrument.

Designed and developed jointly by Sony/Tektronix (Japan) and Tektronix, Inc. engineering teams, it will be marketed by Tektronix Australia and worldwide by all Tektronix subsidiary companies.

The parallel timing analyzer provides eight channels at 20 MHz with 252 bits per channel memory size. The 8-channel parallel word recognizer provides internal triggering upon recognition of preset digital-system state. This capability is expandable to 24 channels with the optional P6406 word recognizer probe. A memory window provides magnification for viewing timing displays.

Digital delay counts up to 65 535 clocks and data can be stored at sample intervals of 50 ns to 200 ms. The stored data is displayed on the self-contained television-type CRT screen in timing format.

The unit has built-in self-test on power up, plus seven levels of diagnostic routines to enable the operator to verify the operation of all data analyzer functions.

The 308 is intended for applications in computer peripheral manufacturing and troubleshooting, industrial process control, telecommunications, electronic test & measurement, and a variety of government applications.

Dot/bar display chips

National Semiconductor has released a new IC series to drive dot or bar-graph displays in applications replacing conventional analogue meters.

Known as LM3914, LM3915 and LM3916, the new devices will drive LEDs, vacuum fluorescent displays or even liquid crystal displays and can provide a log, linear or VU readout.

The LM3914 is a 10-step linear display driver, the LM3915 is a log display driver having a 30 dB range with ten 3 dB steps and the LM3916 is a VU display driver covering the familiar minus 20 to plus 3 VU range.

The IC family can be operated from supplies ranging from 3 V to 20 V and will accept input signals from millivolts to volts.

The LM3914/15/16 family are housed in 18-pin epoxy DIL packages and are available now through NS distributors. For more information, contact NS Electronics, P.O. Box 89, Bayswater Vic 3153. (03) 729-6333.

Local source for Amidon toroids

Most of the US electronics magazines specify toroidal cores in many projects — and local sources are as scarce as rocking-horse dung.

To the rescue comes a small local firm name of US Imports. They have advised us they'll be stocking the following cores:

T200-2
T106-2, T106-6
T50-2, T50-6, T50-10, T50-12
T25-2, T25-6, T25-10, T25-12

These particular cores are the iron powder types, rare in Australia, and were selected to cover the 1 MHz to 200 MHz range for transmitter and receiver applications. Data sheets, price and stock lists are available by sending an SASE. If demand warrants it, US Imports will stock ferrite toroids and beads from Amidon.

You can write US Imports at P.O. Box 157, Mortdale NSW 2223.

Intelligent plotting

An intelligent multipen digital plotter which can provide high quality technical drawings up to A3 (DIN) size has been launched by Philips Test & Measuring Instruments.

The PM 8151 offers a programmable choice of eight pens including standard draughting pens and different colour felt tip pens.

Microprocessor control allows linear interpolation for vector generation, absolute and relative plotting as well as circles and arcs — clockwise or anticlockwise. Up to 120 different characters — upper or lower case — can be printed using five different fonts.

Plotting area is 280 x 338 mm with accuracy of 0.1% full scale and linearity better than 0.01%. Grid marking and X- and Y-axis scaling are possible. Programmable offsets are a feature as well as window plotting — both with off-scale data handling.

Either V24 serial or IEC 625/IEEE 488 bus interfacing is available. An 800 byte buffer — optionally extendable by another 1K byte — provides storage for incoming data. A

ROM expansion allows addition of special characters as well as user-defined subroutines to the standard available software.

Controls are kept to a minimum and arranged logically. Zero and scaling are selectable. A digitising mode allows transfer of point coordinates to the memory of the host computer. Plotting can be stopped at any time without losing data.

The unit operates on 110, 220 or 240 V ac ±10% at 50 or 60 Hz with power consumption around 30 VA. The instrument measures 160 x 466 x 452 mm and weighs 13 kg.

STOCK CLEARANCE

SALE

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Mountain Hardware 100,000 day real time clock.....$300
Solid State Music Video Board 64 x 16.....$83
Jade 8k Static Ram Board (runs at 4 Mhz).....$175
Vector Graphic 48K Ram Board 4Mhz.....$715
Micropolis Disk Controller.....$360
Cromemco D+7a.....$280
Cromemco Eprom Card 8k.....$220
Cromemco Eprom Card 16k.....$300
Box (10) 8" d/d Disks.....$65
Digital Systems 2d disk controller with S-100 interface and CPM.....$700
Shugart 8" SA800 drives.....$500
Digital Systems 4 Shugart drives mounted in 2 cases with power supplies and Disk Controller (double density) cabling and CP/M.....$1900
Hazeltine 1510 terminal.....$1500
Vector Graphics MZ system with VG Terminal and word management.....$5900
Diablo 1345WP daisywheel printer with cut sheet feeder $3500
Diablo model 2300 dot matrix printer.....$3000
30 AMP power supply for S-100 22 slot board and 8" drives.....$400

Sorcerer 32k with S-100 exp interface, 1 Megabyte of 8" disk storage, CP/M.....$4900
8251 Usarts.....$4.50
21L02 Rams.....$0.90
N8T26.....$1.30
6502 CPU.....$8
2513 CHR GEN.....$4.50
44 PIN Edge Connector.....$2.70
S-100 Edge Connector.....$4.20
Encoded Keyboard (GRI).....$60
Unencoded Keyboard.....$46
8080a CPU.....$9
8275 Terminal on a chip.....$55
Mostek Z80 Programming manual.....$8
Basic Programming Library Vols 1-8.....$120
XITAN Codasyl Database with Frortran IV disk runs on Z80a CP/M system (US price $2000).....$1200
Vector Graphics Word Management System.....$480
Durst Processor 8x10.....$658
Negative washing tank.....$20
Timber Computer Cases for S-100 system and drives....$100
Z1+ S-100 computer Z80, 64k, I/O, 2 Shugart 8" disk drives (1 Megabyte) with CP/M.....$7300
Ontel 48k Wordprocessor with twin Shugart disks, 1345 Diablo Daisywheel and stand.....$14,200
Diablo Cut Sheet feeder.....$1620
Computer, 3xMicropolis 5" drives (1 megabyte), 48k Ram, Z80a, I/O, Vector Graphics Terminal, CP/M.....$6400
Graphics Bureau service, colour, plotting, full software with operator.....$40/hr.

A full range of CP/M based software is stocked. Send 3 x 20c stamps for our catalogue or ring 439-1220 for further information. The above prices are valid for 30 days or as long as stock lasts. First come first served. Prices include sales tax but exclude freight. Terms are C.O.D.

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POSTAL: PO Box 745, Crows Nest 2065.
TELEPHONE: (02) 439-1220. TELEX: AA27901.

Science Industry Association

A number of Australian firms have joined forces to form the "Australian Scientific Industry Association". The desire to form the Association arose from an ad hoc meeting of a number of persons and organisations attending a one-day seminar at CSIRO in Canberra in May last year, on "Selling Australian Scientific Instruments to China". The Association's initials, A.S.I.A., are not altogether inappropriate!

In brief, objectives of the Association are: to promote the export of Australian Scientific Instruments, to promote Government and public awareness of the industry and to foster communication within the industry.

The Association has already been active; it is planning a trade mission to China; organised the Victorian Premier, the Hon. R.J. Hamer, to take a number of instruments on his trip to China last year, for presentation to the Chinese Academy of Science; is planning a microfiche directory of the industry and held a one-day conference in Melbourne in late November last year.

Further details of the Association are obtainable from:
Dr R. McCredie
Secretary, A.S.I.A.
c/- CSIRO P.O. Box 225
Dickson ACT 2602.

Hatched, matched, despatched

Brief news on company activities, new outlets, mergers, joint ventures and closures.

Hatched

• Sydney scored two new electronics-type stores late last year — things seem to be jumping in the excitement capital!

First up is the Electronics Centre in Kogarah. They're located in beautiful downtown (or uptown, depending on which way you're heading) Regent St at No. 33A. David East is the helpful host and the phone number is 588-5172. Sashay over you southern suburbs solderers and check it out.

Then there's the Logic Shop. Following hot on the heels of their Melbourne opening, Sydney's Logic Shop Pty Ltd has opened their premises at 91 Regent St, Chippendale. Manager is Andrew Mackintosh who's pretty confident Sydneysiders will soon discover the many advantages of over-the-counter logistics, according to their release. They have a range of computer peripherals in stock to suit a wide variety of needs in small computing applications. For out-of-town callers, the phone number is (02) 699-4910.

Matched

• Philips Industries Holdings Ltd has announced the signing of a memorandum agreement with the Singer Company, Kearfott Div., of Little Falls N.J. in the US, which will lead to Australian design and manufacture of thick-film microcircuits that the Singer Co. uses in a range of inertial navigation systems. Philips will make them at their Hendon, S.A. plant.

• Warburton Franki now represent TRW-Cinch throughout Australia and New Zealand. TRW-Cinch is one of the World's top connector manufacturers (remember the 'Jones' plugs and sockets?). Warburton Franki will be stocking, immediately, 'D' type connectors in Sydney and Melbourne to give off-the-shelf deliveries right now and other types will be added to the range according to market needs.

• Tecnico are now exclusive Australian distributors for the Oxley Development Co., manufacturers of plugs, sockets, pc connectors and pins, ceramic and PTFE trimmers, insulators, indicator lamps, air dielectric trimmers and ball-and-socket connectors.

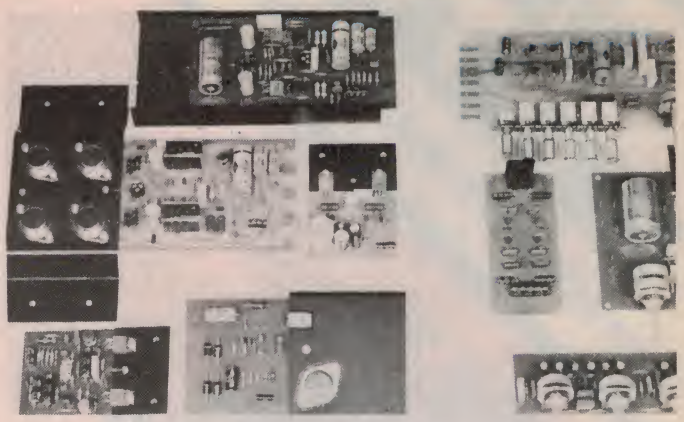
Despatched

• Soanar is now offering a larger range of Raytheon linear ICs through their Melbourne head office and State branches. They are currently holding the following popular ICs in stock (many other specialised types are also available): 4136 — quad 741; 4558 — dual wideband op-amp; 4156 — high performance quad op-amp; 4151 — V to F converter; 4194 and 4195 — dual, tracking voltage regs; 1488 and 1489 — line receivers, and the ubiquitous 555 timer.

All info direct from Soanar.

• Cema are stocking Unitrode, sensitive-gate triacs in TO-92 packages, types: IB202, IB204 and IB206 with blocking voltages rated at 200 V, 400 V and 600 V respectively. This series is compatible with IC logic and are rated at 800 mA. They are ideal for IC or microprocessor interfacing to 240 Vac devices.

Information and samples from Cema.



Autona audio modules

Ralmar Agencies have been appointed distributors for the Autona series of audio modules for the audio enthusiast who likes to roll his own system.

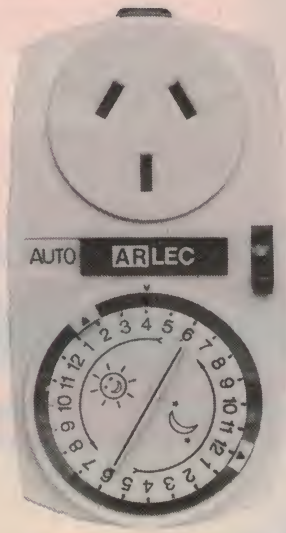
The range includes four power amp modules with ratings from 15 to 125 watts (RMS) output, a power supply stabiliser module, a stereo preamp, a magnetic cartridge head amp, a 12-plus-12 stereo amp, a mixer and an FM tuner.

All modules come completely assembled, ready to wire up, with instructions and specifications.

For more information, brochures etc, contact Ralmar Agencies Pty Ltd, 23 Atchison St, St Leonards, NSW 2065 (02) 439-6566.

Versatile, plug-in time switch

Time switches are not new and have been used in industry for many years to control lighting, heating and various manufacturing processes.



More recently they have appeared in the home as controls fitted to cookers, hot water systems and central heating installations and, as a result, householders are becoming increasingly aware of the convenience and simplicity of using these devices.

However, until recently widespread use of time switches in the home has been limited by the need to connect them permanently to the house wiring.

A&R Electronics Pty Ltd has just introduced the Arlec 'Superswitch'. Designed and manufactured in Australia, it is completely self-contained, plugs directly into any 240 V power socket and provides immediate access for the automatic control of a wide variety of electrical appliances.

The Superswitch is simple to set and operate. Quick-set actuators on the timing dial allow a wide variety of time intervals to be selected. The number of actuators used may be increased or reduced according to the number of on-off cycles required during the 24 hour period.

Programmes can be set to repeat daily or deferred by selecting manual instead of automatic operation.

Further information is available from the manufacturers, A&R Electronics Pty Ltd, 30 Lexton Road, Box Hill, Vic 3128.

NEW RELEASE

from PETERSON SPEAKER LABORATORIES

MODEL 7

MONITOR

COMPARE THIS UNIT WITH
ANY IMPORT UP TO $1,000

We say no more.

SPECIFICATIONS:

TYPE: **BASS REFLEX**
SYSTEM: **2 ELEMENT 2 WAY**
MAXIMUM POWER: **100 WATTS R.M.S.**
MINIMUM DRIVE: **5 WATTS R.M.S.**
SLOPE: **12db x 18db**
BAFFLE: **19mm HEAVY BRACED**
CAPACITY: **40 LITRES**
FREQUENCY RANGE: **25Hz to 20 kHz**
ATTENUATION: **FIXED MONITOR**
COLOUR: **DARK WALNUT**
WEIGHT: **12 KILOGRAMS**
DIMENSIONS: **610mm H, 350mm W. 290mm D.**
DRIVER SIZE: **25cm (10") ROLL**
CROSSOVER FREQUENCY: **2,3 kHz**

stands are included in the design

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$329

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FRANK DAY DOVETON ST NTH BALLARAT VIC.
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OR CONTACT (03) 553 1055 FOR OTHER AREAS.

LETTERS

Dear Sir

I would like to refer to the article "Electronics Rides High on the Boating Boom" by Mr Les Bell (October '79 issue).

There he states that Emergency Position Indicating Radio Beacons (EPIRBs) are not licensable in Australia. This is not correct.

Back in 1976, the Department of Transport, which controls the licencing and operation of EPIRBs, not only has approved two types of flotation VHF/UHF beacons made by Clifford and Shnell and Burndept (BE 369MA) SARBE, but in fact made them compulsory on all Australian registered commercial vessels.

There are currently over 1000 beacons in service. There is also a Burndept Personal Locator Beacon, Model BE 375, approved for use in Australia. This unit has two-way speech facility, range of up to 110 km, is fully waterproof, yet is small enough to fit inside a life jacket or a pocket when in use over land. Over 300 BE 375 units are in service in Australia.

The tough standards set by the DOT were designed to guarantee the operation of EPIRBs under all Australian conditions and prevented substandard equipment from entering the market.

The above beacons have not been made compulsory to pleasure boat owners by the DOT because of their relative cost ($800 to $1200) and because research overseas into coded or satellite based EPIRBs initially promised more advanced and potentially cheaper systems. However, due to continued confusion regarding international standards for the coded EPIRBs, the Australian DOT suspended its current work (NOTICE 15/1978) and recommended the use of existing UHF/VHF EPIRBs by safety conscious skippers. Tomasetti Instruments, who distribute the Burndept range of beacons in Australia, also provide an exchange system for their SARBE BE 369s throughout Australia in order to assure continuous backup of ready to use EPIRBs on vessels in all parts of the country.

Michael Ronsen
Burndept Product Manager
Tomasetti Instruments

Dear Roger

I read with interest R.J.Verrall's letter in your November issue, regarding our aircraft scanning receiver crystals.

Mr. Verrall is quite correct in his assumption that the crystals are designed for a 10.5 MHz IF strip. As such they will not allow operation on the marked channel frequency, when used with a 10.7 MHz IF.

However, all is not lost! By selecting a crystal 200 KHz higher in marked frequency than the desired channel frequency (10.7 MHz – 10.5 MHz) the desired operating frequency can be obtained. i.e. to listen to Adelaide approved frequency 124.2, select a 124.4 MHz crystal for correct frequency.

G.Crapp
Service Manager
Dick Smith Electronics

Dear Sir

In New Scientist about two months ago I saw an ad for the October edition of ETI. It stated that the October edition had details of an electronic model train controller.

I have looked through the October edition of ETI and also the September and November ones without seeing anything remotely resembling such a controller. I was surprised to find that ETI is an Australian publication given that it was advertising in New Scientist - a British publication. Then it crossed my mind that there may be a British magazine of the same name or differing editions of the same international magazine.

I am about to build the electronic controller and would very much like to obtain a copy of this article. Can you assist or enlighten me about the missing article?

Alan Hatfield
ACT

ETI originated in Australia in 1971 and a British edition was started by us a year later. German, Dutch and Canadian editions followed in 1976/77.

Australia's ownership and interests in the overseas editions were sold by the previous owners of Modern Magazines in June 1978. Since that date the overseas editions are autonomous although some material is interchanged between the various editions. Almost all the Canadian projects, for example, are taken from ETI Australia.

In recent months some confusion has been caused in Australia by advertisements run by ETI (UK) in the UK magazine New Scientist – which has considerable readership in Australia. We have asked the UK edition to ensure that any future advertising is clearly identified as relating to their edition of the magazine.

The UK edition of ETI is not available in Australia – nor ours in the UK – however readers may rest assured that features and/or projects of outstanding interest from the UK edition will be suitably adapted and published here – and vice versa. We are currently looking into the feasibility of adapting the model train controller referred to – but no positive decision to publish it here has been made so far.

Collyn Rivers
Managing Editor
Electronics Today International

Sir

An advert for laser devices in your October '79 issue asserted that laser outputs to 5 milliwatts are "completely safe to the human eye".

That's reasonable for diffused laser radiation, but it's a dangerous claim when left unqualified. The unwary can wrongly apply it to a direct or reflected, highly collimated laser beam, when no such beam at **any** power level should be deemed safe.

Even the risk of damage to one's photo-sensitive skin from such low-level laser exposure can't yet be assessed as the laser simply hasn't been extant long enough to do so.

Recall that not too many years ago **all** radio-frequency (RF) energy was considered benign. Yet now we know (or should) that even low-level microwaves can cause capsular cataracts.

As RF nears the frequency of light it begins to assume some of the characteristics of light (as do microwaves). If it demands respect, so also does coherent light itself.

George Lindley
Sydney

You are correct Mr.Lindley, lasers do present a hazard to eyesight.

Courses and careers in electronics

Roberta Kennedy

If you're considering some sort of career in electronics, then you're a candidate to read this article. Here is a guide to the various sorts of courses available for the various 'streams' of possible employment. Also included is some information on what you can do in electronics and the pay levels available.

THE PAST FEW DECADES have seen an increasing dependence on electronics in more and more areas of modern living. Today, electronics is probably the most rapidly expanding field of technology, and its applications are becoming increasingly widespread and complex.

In keeping with this trend, educational institutions have introduced a great number of electronics/electrical courses, so that the prospective student is now faced with a confusing range of possibilities.

As electronic technology becomes more complex, so the need for trained tradesmen, technicians and engineers becomes more pressing. Recent statements from the Institution of Engineers and the Department of Employment and Youth Affairs indicate that the 1980s will see an acute shortage of trained personnel in this field, and this is already reflected in the rising salaries being offered in the private sector.

In view of this increased demand, it is obviously a good time to be enrolling in an electrical/electronics course. The only problem is in deciding, from the many alternatives available, which course is best for the type of work you want to end up doing. This article is an attempt to outline the various types of courses, and to show what they can lead to. Computer courses are an enormous area of education in themselves and will be dealt with in a future article.

Levels of employment

Anyone contemplating a career in electronics should first be aware of the various levels of employment and the associated courses of study required. The following is a broad outline, which may help those who are unsure of the difference between, for example, a technician and a technical officer.

Tradesman

The term 'electrical trades' covers electrical fitters, armature winders, electrical mechanics, meter mechanics, linesmen and auto electricians. In general, these people are involved with the manufacture, installation, maintenance and repair of electrical equipment, either in their own businesses, private industry or government departments and agencies.

In order to become a tradesman you must obtain an apprenticeship, which involves four years service and three years concurrent study in an electrical trades course at technical college.

Electrical trades courses provide theoretical and practical instruction necessary for apprentices in the electrical, electronics, communications and instrumentation industries. This training is supplementary to that gained on the job.

College attendance is normally based on the 'day release' system in which an apprentice spends one day per week at tech. In some trades there is also provision for 'block release' with alternating periods of work and full-time college study. Correspondence tuition is available for those who are unable to attend college.

Some TAFE colleges have a **shortened apprenticeship scheme** for the electrical trades course which involves 18 weeks full-time study, followed by part-time attendance one day per week until completion. This scheme is open to students under 21 years of age providing they have the required general education standards. A further reduction of apprenticeship is available for students with Year 11 (form 5) qualifications.

Educational requirements for apprenticeship vary from one employer to the next, but it is generally agreed that the minimum standard would be a pass in maths, science and one other subject at Year 9 (form 3) level. Many employers prefer School Certificate holders, and obviously the better your grades at high school, the better your chances are of obtaining an apprenticeship.

Completion of the apprenticeship school course gains you the Trade Proficiency Certificate, and a further year of part-time study will make you eligible for the Trade Technicians' Certificate.

Pre-apprenticeship courses are available at selected metropolitan and country colleges for one year part-time. Those who obtain an apprenticeship after successful completion of a pre-apprenticeship course can then proceed to Stage III of the appropriate trade course. These courses have a limited intake of students and generally require School Certificate or equivalent. Students must also be under 20 years of age.

Technician

A technician's job may involve repairs and maintenance, installation and servicing of equipment for offices, hospitals and industrial plants, working with engineers on new designs, production supervision etc. Others set up businesses selling and repairing electronic and electrical equipment. The most common areas of employment are in the digital/computer, television and communications industries.

The **Technicians' Certificate** course is based on the Electronic (or Electrical) Trades course, but technicians are expected to pass subjects at a higher level than that required of apprentices. In addition, a technician may be required to have one year's job experience before receiving his certificate.

Courses for technicians are generally available either full-time (two years) or part-time (four years), with options in the final stages including television receivers, television studios, communications and digital/computer studies.

The Technicians' Certificate can also be achieved through completion of the apprenticeship course plus passes in Year 11 (form 5) maths, science and english and recognised post-apprentice units.

Technical Officer

Technical officers, engineering assistants and design draftsmen are required to complete a two year (full time) or four year (part time) certificate course, in conjunction with a minimum of two year's employment in the industry. Approved courses are the Certificate of Technology (Electrical) or Higher Technicians' Course in Victoria, the Electronics and Communications Certificate (NSW and Qld), the Electronic Technicians' Certificate (SA) and the Diploma of Electronic Engineering (WA), among others. More information on specific courses is given later in the article.

Entry requirements vary from state to state, but generally a pass in maths, science and english at Year 11 level or equivalent is required.

Technical officers, engineering assistants and design draftsmen work as immediate support staff for professional engineers and scientists. They should have a combination of practical skills and theoretical knowledge, in order to communicate effectively with both tradesmen and engineers.

Many State and Commonwealth government departments, as well as private manufacturing and equipment service/supply organisations employ technical officers in design offices, laboratories, maintenance workshops and in field work. Others find employment in technical sales.

Practical instruction in electronics at Collingwood Technical College (Vic.)

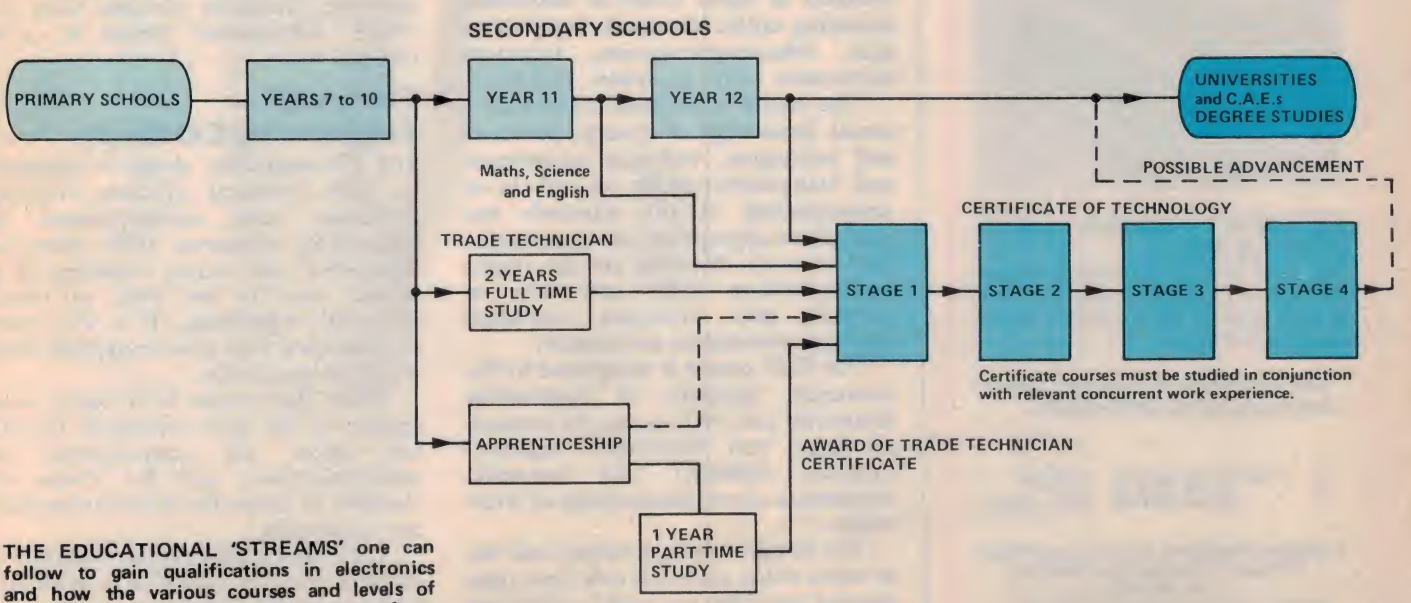
Professional engineer

An electronics engineer is someone who has obtained an engineering degree or diploma from a University, Institute of Technology or College of Advanced Education. Admission to these institutions usually requires the HSC with good passes in maths, physics and english.

The basic degree course is four years full-time, with the first two years covering advanced maths and physics and a number of electronics electives being available in years three and four.

Degree courses provide training in the method and practice of dealing with new designs and solving problems in a whole range of situations. They do not, however, provide a strong technical training, as this is generally presupposed. A good engineer must have a sound technical understanding, but he will have to gain this through his own involvement in designing and building projects, rather from the course itself. On the whole, CAEs and ITs have a heavier industrial/technical slant than universities.

At some universities (e.g. NSW and Sydney) it is possible to do a combined BE/BSc degree, which is five years full-▶ time.



THE EDUCATIONAL 'STREAMS' one can follow to gain qualifications in electronics and how the various courses and levels of study are related. (Although this is from Victoria, it generally applies in most States).

Colleges of Technical and Further Education (TAFEs) provide by far the greatest number of electronics courses available in Australia today, ranging from basic electronics through to the Electronics and Communications Certificate course.

These colleges are widespread throughout the city and country areas – in NSW alone there are some 25 different colleges and techs which provide some form of electronics training – and the number is growing.

There are just too many TAFE colleges in Australia to provide details of all the different electronics courses available, but those described below should provide a basic outline as there are only slight differences between courses the various states.

The School of Electrical Engineering in NSW has its headquarters at North Sydney Technical College. The college offers certificate courses in Electrical Engineering, Electronics and Communication and Power Generation, and post-certificate courses in Electrical Engineering and VHF Techniques.

Certificate courses are available either full-time or part-time, with full-time students receiving around twice as many hours tuition per subject as well as tutorials, which would appear to give them somewhat of an advantage over part-time students.

Electronics and Communications Certificate

Commonly regarded as one of the most useful electronics courses available, the E&C certificate provides training for personnel in paraprofessional positions such as technical officer or engineering assistant in many fields of electronics including radio, television, navigational aids, telecommunications, industrial electronics and computer hardware.

The course is designed to provide a sound knowledge of theory, processes and techniques, technical competence and manipulative skills, as well as an understanding of the standards and regulations appropriate to the particular field of work. Students are also taught communication skills and how to prepare and interpret technical drawings, documents and reports.

The E&C course is recognised by the Australian Institute of Engineering Associates Ltd (AIEA) and the Institute of Radio and Electronics Engineers Australia (IREEA), and successful completion allows membership of these bodies.

The course is in four stages, and can be taken either part-time over four years (around ten hours per week) or full-time over two years with some specialist subjects being completed in a third year. Stages I and II, and core subjects of Stage III are also available by correspondence, although the relevant practical work has to be completed at the end of each term by full-time attendance for one week at a metropolitan technical college.

The School Certificate is a prerequisite for entry to the certificate course, with passes in english at Year 10 (form 4), maths at Year 9 (form 3) and a standard of science satisfactory to the School. Preliminary or concurrent studies in these subjects are available if required.

Stages I and II of the course (1st and 2nd semesters for full-time students) cover technical communications, maths, physics, engineering materials, electrical technology, electronics and circuit analysis. In addition, full-time students are required to spend three hours weekly on workshop technology, and four hours weekly on the curiously named "life oriented studies", which deals with "the functioning of the human being in the modern industrial environment". Full-time students continue with life oriented studies and electrical engineering practice, in addition to core subjects, in the first semester of Year II.

Stage III introduces a number of electives, enabling students to specialise, and these are expanded in Stage IV to include analogue techniques, communications measurements, communications techniques, data communications, digital computers/software and techniques, radio communications, television and further electronics.

At the time of writing (November '79) the E&C course was under revision. Details of any changes to the course structure should be obtained from the TAFE Information Centre in your capital.

Electrical Engineering Certificate

The EE certificate course is designed to train technical officers, electrical draftsmen, area superintendents or engineering assistants with electrical authorities and others working at a similar level in the field of heavy industrial engineering. It is also open to tradesmen who want to upgrade their technical knowledge.

While this course is in many ways similar to the E&C certificate, it does not allow for specialisation in communications, and the choice of electives in Stage IV is neither as wide nor as versatile.

The course covers general engineering subjects such as technical communications, maths, physics, engineering materials, electrical technology and ▶

How to crack a highly paid job as an electronics technician.

We'll give you excellent training - as good as you'll get anywhere in Australia.

We'll give you free medical, dental and hospital treatment.

We'll provide plenty of good tucker and a comfortable place to stay.

We'll give you substantial leave, and on top of all that, we'll pay you well while you're training.

On your side, you'll give us a period of hard, but interesting and rewarding work. And, when eventually you leave us, you'll find yourself a fully qualified and experienced Electronics Technician. Not a bad thing to be, these days.

So, if electronics is your idea of a great career and you are (at time of entry) approx. 15 to 17 for apprenticeship and over 17 for an Adult Trainee, join the Navy, Army or Air Force.

Phone us at:
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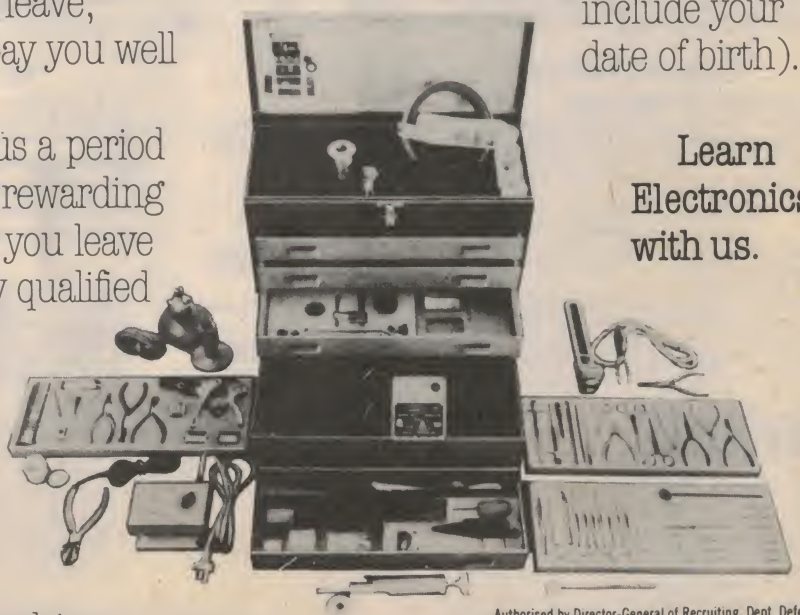
Canberra 822 333 Hobart 34 7077.
Melbourne 61 3731. Perth 325 6222.
Sydney 212 1011.

Write to either the Navy, Army or Air Force Electronics Technician Counsellor, GPO Box XYZ in your nearest State Capital City (please include your date of birth).

Learn Electronics with us.



Authorised by Director-General of Recruiting Dept. Defence.
TSAP15.FP.48

circuit analysis, with electronics being introduced in Stage II. A number of electives are available in Stage IV, including transmission, mining legislation and technology, electronic power control, generation, distribution and utilisation, electrical measurements and colliery or mining electrical engineering.

Entry requirements, course duration and correspondence facilities are the same as for the E&C, and the Electrical Engineering certificate is also recognised by the AIEA and IREEA.

This course was also under review in 1979, and details of changes can be obtained from the TAFE Information Centre in your capital city.

Post-certificate courses

Very High Frequency Techniques (one year, nine hours weekly). This course is available to students who have completed the E&C certificate. It aims to provide a specialised knowledge of the techniques required to cope with the problems encountered in electronic communication at very high frequencies. It involves three hours per week each in maths, laboratory and VHF techniques.

The School of Electrical Engineering also conducts several short specialist courses suitable for the technician who wants to acquire specific skills and knowledge in certain areas related to computers and special electronic devices and techniques. More information on these courses is available from your nearest TAFE Information Centre.

Medical Electronics (one year, three hours per week). This course is conducted by the School of Biological Sciences and at present is available in NSW at Sydney Technical College only. It is designed for those who are employed in a medical field involving the use of electronic equipment and apparatus and who have completed the E&C Certificate course.

Sydney Technical College is the headquarters of the School of Applied Electricity in NSW. In addition to certificate courses in film and television which are outside the scope of this article, Sydney tech has a number of Trade Courses including Consumer Electronics, Electrical Trades, Radio and Telegraph Mechanics. Their post-trade courses include automative electronics, industrial electronics, semi-conductor electronics, advanced electrical trade drawing and just plain electronics.

A vast number of Special Courses and several Pre-Apprenticeship courses are also available at Sydney Tech. (more details following)

Trade courses

Consumer Electronics is a one-year course involving twenty hours per week (daytime). It provides training in the servicing of consumer electronic equipment such as radios, tape recorders and television sets, in conjunction with on-the-job experience. Five half days per week are spent at tech, and the rest is devoted to concurrent on-the-job practical training.

Entry requirements are the Higher School Certificate and (preferably) a nomination from an electronic industry organisation. Consideration is also given to employer nominations of mature applicants with appropriate industrial experience.

The **Electrical Trades Course** provides training in basic principles and manual skills to complement the industrial experience of electrical trades apprentices and electrical fitter/mechanics.

The diversified course structure and wide range of electives in Stage III are designed to meet the needs of apprentices from a variety of industrial backgrounds.

Students obtain experience with a wide range of procedures and equipment not always available on the job.

The normal attendance pattern is one day per week for three years, but the ▶

course is also available by block release and under the shortened apprenticeship scheme.

Post-trade courses

These are designed for tradesmen and apprentices needing retraining or specialisation, and are oriented towards the industrial applications of electronics.

The **Electronics PTC** is a certificate course in which students undertake a total of 216 hours of study. The choice of units includes digital principles and applications, electronic equipment servicing, power control, industrial controls, industrial sound systems and synchro-hardware.

Admission to this course is restricted to those who have already completed Stage I of the Industrial Electronics or Semiconductor Electronics post trade course at Strathfield Technical College. Both these courses involve six hours per week for one year.

Basic Electronics

This is **not** a certificate course, but comes under the category of Special Courses. It is the most widely available of TAFE electronics courses, being designed to provide a foundation of electronic and electrical principles for tradesmen and others in the industry.

The course involves three hours per week for one year, or six hours per week for 18 weeks.

Electronic (hi-fi) Salesman

This Special Course involves four hours per week for one year and provides an understanding of the physics of sound and of consumer electronic apparatus. It is designed for audio electronics salesmen.

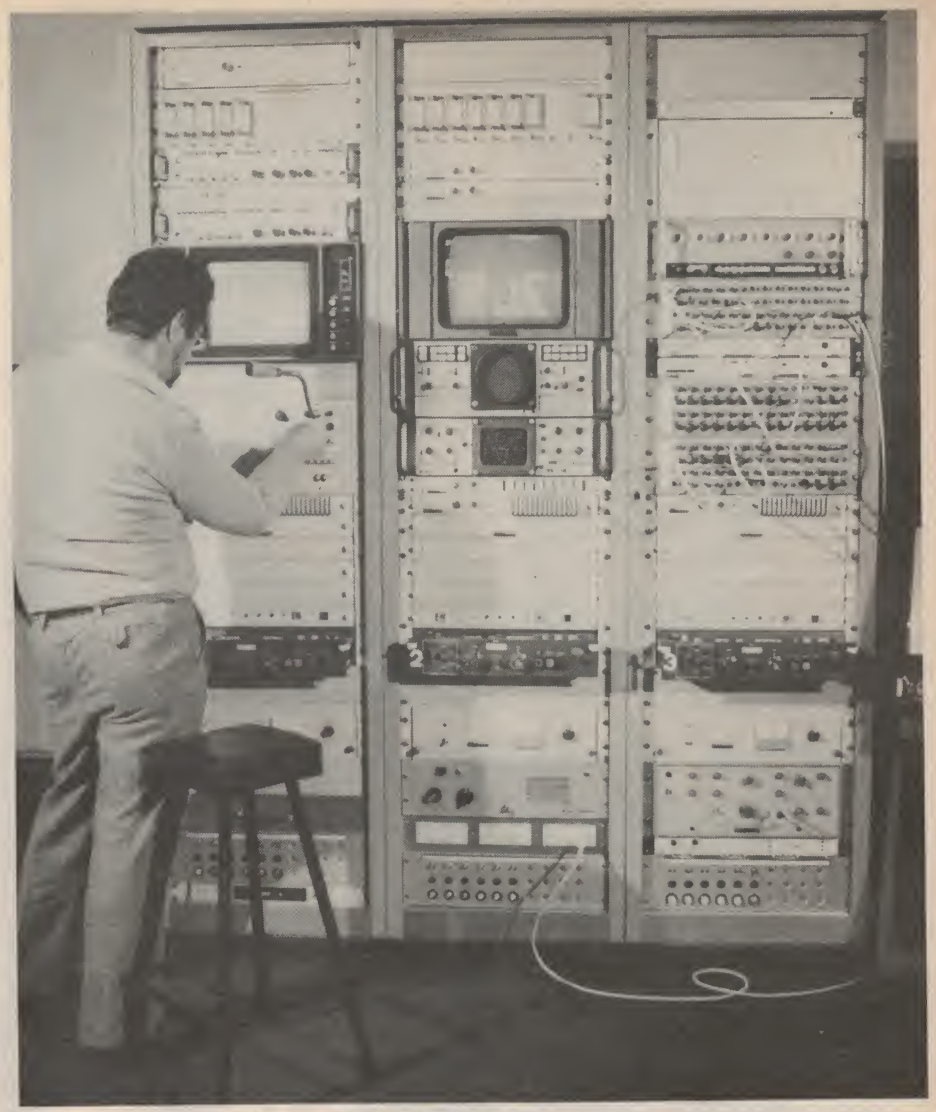
TV and Radio

To work as a technician in the radio or television industries you may need a Broadcast Operators' Certificate of Proficiency or Television Operators' Certificate of Proficiency. These are issued by the Regulatory and Licensing branch of the Department of Post and Telecommunications (Auntie Pat), after passing an examination.

Courses to prepare for this exam are provided at a number of technical colleges (e.g. Box Hill, Sydney Tech) and private institutions. Curriculum details can be obtained from your local P&T branch office.

TAFEs

Box Hill Technical College is a well-established TAFE college offering a wide range of electronics courses at different levels. The Electronic Trades Department offers a pre-vocational course, apprenticeship and post apprenticeship courses, the Trade Technician course and adult education evening courses in electronics.



You could operate television transmission equipment . . .

The **Pre-vocational course** (one year full-time) is designed to give Year 10 (fourth form) students a general education and the basic vocational skills required for the electronics industry. On completion of the course a student can either become an apprentice or attempt a trade technician or Certificate of Technology course.

Entry to the Apprentice course requires a minimum age of 15 and satisfactory completion of Year 10 (fourth form) high school. Attendance patterns are variable but a minimum total of 960 hours is required. Completion of the full course gains the Certificate of Proficiency.

A wide range of post-apprentice courses and/or subjects are available at Box Hill, with day or evening classes. These include radio receivers (AM and FM), communications and digital electronics. Details of topics and prerequisites can be obtained from the college.

The **Technicians Certificate** course is available either full-time (two years) or ▶

part-time. Year 1 is the same as the first stage of the trade course, with maths science and english at Year 11 (form 5). Year 2 offers a choice of electives in television receivers, communications, TV transmission and computers. Subjects available for part-time study in 1980 are pulse circuits, circuit analysis, microprocessor systems and microprocessor applications. One year of work experience is required before being granted the technicians certificate.

The **Certificate of Technology** (general electronics or computer electronics) is equivalent to the E&C Certificate in NSW. The course is in four stages with subjects in each stage available on a semester or whole year basis. The time required to complete the course depends on the mode of attendance chosen, but two years of full-time equivalent in conjunction with two years of relevant employment is the minimum.

Entry requirements are passes in Year 11 physics, maths and english (minimum) or approved equivalent. Some exemptions in Stage 1 are available for HSC subjects.

Royal Melbourne Institute of Technology (RMIT) has an Electronics Division and a Telecommunications Division, both of which provide electronics training.

The Electronics Technology Division offers a four-stage course in the **Certificate of Technology** which is the qualification required for Technical Officer gradings. Electives are available to allow specialisation as required, and practical subjects such as electronic construction techniques, machine shop practice and drafting are included.

The Telecommunications Division of RMIT offers a wide range of courses covering most areas of electronics. The **Electronics Technician Course** can be taken over two years full time, one year full time plus 12 hours per week (part time) for two years, or four years part time (12 hours per week). After completing the basic stages of the course, specialised streams are available in television transmission, computers, television receivers, and communications.

Alternatively, there is the **Electronics Mechanics Course** for apprentices and non-apprentices, which can be taken as a three year course involving one full day per week or two four-hour evenings per week, or a two-year course requiring two days per week in the first year and one day per week in the second year. The specialised streams in this course are communications, radio and TV receivers, broadcasting, computers and industrial electronics.

The minimum entrance requirement for either course is a pass in maths, science and english at Year 10 (form 4) level, or equivalent.

. . . or work with video testing equipment.

RMIT also offers a number of post graduate subjects including advanced audio, video tape recorders, remote controlled television receivers, radar and microprocessors. Other subjects aimed at assisting students in obtaining certificates issued by the Dept. of Post and Telecommunications include broadcast operators, television operators, amateur radio and a general certificate of proficiency.

Newcastle Technical College provides a wide range of electronics training courses at both amateur and trade levels, including post trades television, radio transmission, industrial electronics, basic electronics, two-way radio users course and television studio techniques, in addition to the Electronics Trade Course.

The Electronics Trade Course replaces the older Radio Trades course, and has been broadened to include both analogue and digital techniques. A range of optional subjects in Stage 3 allows specialisation for particular areas of the industry.

Collingwood Technical College has courses at the trade, technician and para-professional levels including Certificates of Technology in Electronics with specialist electives in computer electronics. In addition there are a number of short courses in digital electronics which are suitable for technicians and others who wish to update their knowledge of current technology. ●

ETI's multi-talented production editor, Roberta Kennedy, concludes next month with coverage of CAEs, Universities and Employment.

NEW KITS
(and new kit components)

Remember: parts for most kits in most of the electronic magazines are normal stock lines. So even if a kit isn't listed, we may be able to help you anyway. Call in and ask us!

SUPERBASS FILTER (See EA January)
Printed Circuit Board ..... Cat H-8370 ..... $2.40

FLASH EXPOSURE METER (See EA January)
Printed Circuit Board ..... Cat H-8371 ..... $2.10
Solar Cell ..... Cat Z-4820 ..... $2.50

GUITAR PRACTICE AMPLIFIER (See ETI January)
Printed Circuit Board ..... Cat H 8625 ..... $4.60

PLAYMATE AMPLIFIER (See EA January)
Printed Circuit Board ..... Cat H-8639 ..... $4.60

TRANSISTOR ASSISTED IGNITION (See EA December)
Complete kit including instructions ..... Cat K-3300 ..... $32.50
Printed circuit board ..... Cat H-8367 ..... $2.20
BUX80 power transistor ..... Cat Z-2150 ..... $10.95

FAN SPEED CONTROL (See EA December)
Short form kit (PCB, components: no h'ware) ..... Cat K-3090 ..... $11.50
Printed Circuit Board ..... Cat H-8368 ..... $1.60
SC141D Triac ..... Cat Z-4510 ..... $1.28
(zippy box, etc, normal stock lines – or build it in to appliance.)

NEW METAL LOCATOR (See EA November)
Complete kit (excluding dowel & former) ..... Cat K-3504 ..... $19.50
Printed Circuit Board ..... Cat H-8366 ..... $2.40

INFRA-RED REMOTE CONTROLLER (See EA October)
CQY89A Infra red diodes ..... Cat Z-3235 ..... $1.50
BPW34 photo transistors ..... Cat Z-1954 ..... $3.50
Printed circuit boards (pair) ..... Cat H-8365 ..... $5.95

PROCESS TIMER (See ETI October)
Printed circuit board ..... Cat H-8623 ..... $3.95

DISCO STROBE Mk 11 (see ETI September)
Complete kit, including instructions ..... Cat K-3152 ..... $34.50
Printed circuit board ..... Cat H-8572 ..... $1.95
Flashtube ..... Cat S-3882 ..... $2.95
Trigger transformer ..... Cat M-0104 ..... 90c
Discharge capacitors (each) ..... Cat R-2855 ..... $3.75
Reflector ..... Cat K-6016 ..... $4.50

WINDSCREEN WIPER DELAY (See EA September)
Printed circuit board ..... Cat H-8364 ..... $2.50
Other components for this project are normal stock lines.

AUTO CHIME (See EA September)
Complete kit ..... Cat K-3502 ..... $29.75
Printed circuit board ..... Cat H-8363 ..... $3.70
TMS-1000 Integrated Circuit ..... Cat Z-6825 ..... $16.50

INDUCTION BALANCE METAL DETECTOR (See ETI)
Short form kit (not inc. dowell or former) ..... Cat K-3100 ..... $35.50
Printed circuit board ..... Cat H-8578 ..... $1.50

MASTHEAD AMPLIFIER (See EA August)
Complete kit ..... Cat K-3232 ..... $29.50
Printed circuit board ..... Cat H-8362 ..... $2.50
OM350 integrated circuit ..... Cat Z-6185 ..... $9.95
Diecast box ..... Cat H-2221 ..... $3.00
Zippy box ..... Cat H-2751 ..... $2.50

JUST RELEASED!

Our brand new, up-dated colour kit catalogue is now available.
Send for your copy NOW – it is

FREE!

MAJOR DICK SMITH RESELLERS

Listed below are re-sellers who stock a large range of our products. However, we cannot guarantee that they will have all items in stock or at the prices we advertise.

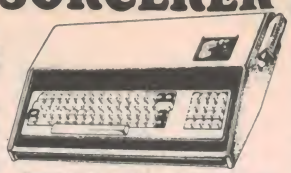
A&M Electronics
78 High Street, Wodonga, Vic. Ph 244 588
Advanced Electronics
5a The Quadrant, Launceston Tas. Ph 317 075
Aero Electronics
123a Bathurst Street, Hobart Tas. Ph 348 232
Peter Brown Electronics
9 Doveton Street North, Ballarat Vic. Ph 323 035
Crystal TV Rentals Pty Ltd
66 Crystal Street, Broken Hill NSW. Ph 6897
Decro Electric
Cnr Magellan St & Bruxner Hwy, Lismore NSW. Ph 214 137
Elektron 2000
44 Brown Road, Broadmeadow, Newcastle NSW. Ph 691 222
D & M Harrington
6/1 Machinery Drive, Tweed Heads South, NSW. Ph 364 589
Hutchesson's Communications
5 Elizabeth Street, Mt Gambier SA. Ph 256 404
Keller Electronics
218 Adelaide Street, Maryborough, Qld. Ph 214 559
M & W Electronics
48 McNamara Street, Orange NSW. Ph 626 491
Mellor Enterprises
Shop 2/15 Forsythe St, Whyalla Norrie, SA. Ph 454 131
Power & Sound
147 Argyle Street, Traralgon, Vic. Ph 743 638
Purely Electronics
15 East Street, Rockhampton, Qld. Ph 021058
Stevens Electrical
42 Victoria Street, Mackay, Qld. Ph 511 723
Sumner Electronics
95 Mitchell Street, Bendigo, Vic. Ph 431 977
Sound Components
78 Brisbane Street, Tamworth NSW. Ph 661 363
Trilogy Wholesale Electronics
40 Princes Hwy, Fairy Meadow, Wollongong, NSW. Ph 831 219
Tropical TV Services
249 Fulham Rd, Vincent, Townsville Qld. Ph 791 421
Variety Discounts
113 Horton Street, Port Macquarie NSW. Ph 835 486
Wagga Wholesale Electronics Sales
82 Forsyth Street, Wagga NSW.
Wellington Electrical Services
110 Lee Street, Wellington NSW. Ph 325

COMPUTER CORNER . . .

NEW SORCERER II.

UPGRADED! The BEST is now BETTER!

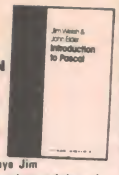
Yes! The world's best value in home computers has become even better value!
As part of their ongoing research & development, Exidy (the Sorcerer's makers) have made some circuit changes giving the Sorcerer on-board capability of up to 48k RAM plus even greater reliability!
There are a lot of small computers around now – but there is only one Sorcerer.



Sorcerer II (8k RAM) Cat X-3000 ***$1095.00***
Sorcerer II (16k RAM) Cat X-3001 ***$1250.00***

SORCERER USER'S GROUPS
SYDNEY: Meets 1st Friday odd months 2nd Friday even months at 14 Atchison St. St Leonards at 7.30
ADELAIDE: Contact Dr P Delin, c/- Psychology Dept, University of Adelaide, for further details.
For information or contacts in local groups in Melbourne, Ballarat, Canberra, Brisbane, Manilla, Hong Kong, Singapore & Fiji contact the Secretary, Aust. Sorcerer Users Groups, PO Box 43, Peakhurst 2210

'INTRODUCTION TO PASCAL' (Welsh & Elder)



$13.95

'Highly recommended' says Jim Rowe. Pascal is the latest 'state of the art' computer language – if you're a computer enthusiast, this 282 page reference will tell you all you want to know. Cat B-2365

E-X-P-A-N-D IT

To get the most from your computer, you need to put more into it! More memory, that is. Expand your Sorcerer, Apple, TRS-80, etc, with our memory upgrade kit. 8k to 16k, 16 k to 32k, etc. Compare our prices to theirs!

$149.50

Cat X-1185 for Sorcerer
Cat X-1186 For TRS-80, Apple

PROGRAM TAPES:
Use your home computer to advantage with these tapes:

FOR THE SORCERER:	
Magic Maze	(Cat X-3620) $14.95
PLOT	(Cat X-3621) $17.95
Z-80 DISASSEMBLER	(Cat X-3622) $17.95
SHAPE MAKER	(Cat X-3623) $17.95
DEBUG	(Cat X-3624) $17.95
FASTGAMMON	(Cat X-3625) $22.95
YAHTZEE	(Cat X-3800) $9.95
BALCKJACK	(Cat X-3602) $9.95
WUMPUS	(Cat X-3604) $9.95
FOR THE TRS-80:	
TIME TREK	(Cat X-3650) $17.95
STIM. SIMULATIONS	(Cat X-3652) $17.95
ELECT. PAINTBRUSH	(Cat X-3654) $17.95
BRIDGE CHALLENGER	(Cat X-3656) $17.95
MICRDCHESS 1.5	(Cat X-3658) $22.95

COMPARE OUR PRICES WITH THEIRS!
(For fuller description see our adverts last month).

JAMIESON ROWE, Australia's leading expert on home computers, is now with Dick Smith Electronics.

GREAT NEW KITS – TRY ONE!

Transistor assisted ignition kit – saves $$$

$32.50 Cat K-3300

CDI IS OUT – TRANSISTOR ASSISTED IGNITION IS IN . . . So says Leo Simpson in December Electronics Aust. Build this simple, yet reliable transistor assisted ignition and start saving your petrol dollars. The transistor assisted ignition has the advantages of the CDI, without the disadvantages.
Our kit includes pre-punced metalwork and the recommended heatsink.

The Autochime: 24 tune doorbell

Here's a doorbell you can build yourself. Just like our built-up version, but you save because you supply the labour. Auto advance to next tune; mains powered. Surprise your friends and neighbours!

$29.75

Cat K-3502

Don't want to build it yourself? See the next page for a fully built-up 24 tune doorbell!

DICK LIGHTS UP!

For the camper, in the car, around the home: this 3-way light is brilliant! Has fluoro tube for overall lighting, bright spot for outdoors or a bright orange safety flasher. Outstanding value. Cat X-1084

$14.95 Cat X-1084

AMATEURS:
DON'T FORGET: DICK SMITH WILL MATCH ANY OR BETTER ANY GENUINE PRICE (ADVT. IN AUST.) ON YAESU AMATEUR RADIO EQUIPMENT.

PROJECT BUILDING?

Here's the best value in a relay around: on-board mounting, wide operating range (7 to 15 volts) so they're ideal for a variety of circuits, and 200mA contact rating. Great for the junk box: you never know when a relay is going to be needed!

$2.00 Cat S-7120

DICK'S OWN Amateur Radio Handbook

Written especially for AUSTRALIAN conditions, contains loads of info for the amateur and budding amateur.

$6.95 Cat B-2320

6 LEVEL CHESS COMPUTER

Play against a beginner or a master. The chess computer can play at any of 6 levels. Ready for a quick blitz or a slow, thinking game. Comes with bonus chess set. Operates from internal batteries or optional mains adaptor. Cat X-1250

VALUE! $99.50 Plus batteries

25-IN-ONE SOLAR EXPERIMENT KIT

Here's value for the budding scientiste in the family! Dick's own 25-in-one kit will keep them amused for hours. Safe and educational, too!

Cat K-2032

$16.95 COMPLETELY SAFE!

TRIED IT YET?

The new Yaesu 2 metre hand held with microprocessor control: it's a winner!

Yes, this new Yaesu has to be seen to be believed. A full 2 metre (144-148MHz) hand held with 'touch tone' frequency selection, auto scanning in three modes, repeater splits of any description, LED readout, channel memory, in-built NiCad battery pack, and much, much more: all in a powerful transceiver that fits into the palm of your hand. It's a technological breakthrough that you must see for yourself – at your nearest Dick Smith store.
Cat D-2888

$358.00

TERMS AVAILABLE TO APPROVED APPLICANTS

LOOK! An LCD digital watch with alarm ● stopwatch ● split timing

Compare the value. Others sell similar watches for $100.00 and more. Look at our price! Quality electronics (made by one of the largest manufacturers in the world) and looks really impressive. Shows day/date/full time, plus alarm time set, stop watch time, lap times, etc. A brilliant gift idea!

Compare elsewhere at $100 and more! Our price:

$49.50

Cat X-1044

EVERYTHING you want on 6m!

Cat D-2886
$795

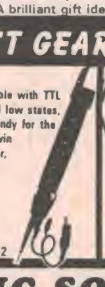
That's right – everything! AM, SSB, CW, FM – any mode you want to operate on. It covers from 50 to 54MHz (just in case we ever get the extra 2MHz!) AC and DC supplies are built in, so there's no power supply to pay for. 25 watts – more than enough output (25W on FM, CW & SSB). All the features you'd expect to find on a Yaesu – in short: magnificent!

NEW TEST GEAR FROM DICK

LOGIC PROBE.

Superb instrument: compatible with TTL and CMOS, shows high and low states, pulses, etc. Easy to use, handy for the experimenter's work box. Twin alligator clip leads for power, separate earth clip & probe.

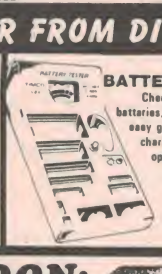
$27.50 Cat Q-1272



UNIVERSAL BATTERY CHECKER

Checks virtually all common batteries, lamps, fuses, etc, with easy go/no go check. Also recharges nicad batteries with optional plugpack adaptor.

$9.95 Cat Q-1525



LAST CHANCE!

LIMITED STOCKS ONLY OF THE WIA 1979 CALL BOOK.

If you hang on any longer, you may miss out. We have only a few copies left. Lists amateurs and SWLs in Aust & PNG, plus loads of data. Every amateur & SWL needs a copy!

Cat B-2317 **$2.95**

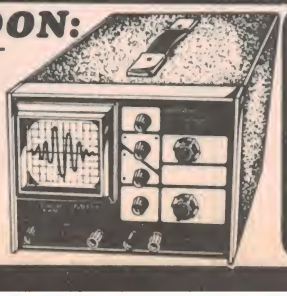
COMING SOON:

DICK SMITH 75MM CRO – UNDER $200.00!!!!!

Yes! A 5MHz laboratory oscilloscope just right for the service technician, amateur, audio buff, student, etc – and it is less than $200.00. Made especially for Dick Smith, this easy-to-use CRO should be available next month. It's worth the wait!

$199.00 Cat Q-1280

Don't buy a CRO until you see this one!



BUYING BY MAIL?

It's so easy! Simply list the items you want, with their catalogue numbers, and post it off with your cheque to our mail order centre (address at right). Don't forget to include post & packing (charges apply to total order value as per table at right). Then watch your letterbox!

ORDER VALUE:	P&P
$5 (min) to $9.99	$1.00
$10.00 to $24.99	$2.00
$25.00 to $49.99	$3.00
$50.00 to $99.99	$4.00
$100 or more	$5.50

NOTE These charges apply to goods sent by post in Australia only. Large and bulky items cannot be sent by post.
If you prefer, we will despatch your order by Comet Road Freight to anywhere in Australia for only $6.00 – that's below what it costs us! Large and bulky items are normally sent by Comet unless you specify differently (eg by rail or air – you pay freight on delivery).

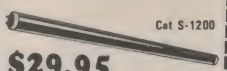
SUMMER PARTY TIME . . .

Get your parties really moving this summer with special lighting effects from Dick Smith.

MUSICOLOR Mk 3
Turn music into light! Plugs into any amplifier (won't harm or effect it) and uses music tones & strength to modulate light. A beauty! With full instruction book. Cat K-3140

$65.00

DICK SMITH KITS COME COMPLETE, WITH FULL INSTRUCTIONS TOO!



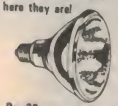
Cat S-1200

$29.95

40 WATT UV FLUORO
Easy & effective party lighting! Just replace your 40W fluoros with these UV tubes. Clothes fluoresce in strange colours, yet it is completely safe. (NOTE: Be careful with some cheaper 'UV' tubes which may be harmful to the eyes. Our tubes are specially made to minimise short wave length UV).

Lights to suit Musicolour:
You asked for them — here they are!

White bakelite Edison screw lampholders. Simple to wire, screw holes for flush mounting. Cat P-5620 **$3.50 ea**



Par 38 pressed glass floodlamps in 4 cols. with internal reflector. Yellow (S-3850) Red (S-3852) Blue (S-3854) Green (S-3856) **$7.95 ea**

NEW DISCO STROBE
Recently up-graded, now even more reliable. Brilliant white light flashes makes motion freeze, stunning effect. Easy to build kit, complete with instructions.

$34.50

Cat K-3152

DICK'S PLUGPACKS

3-6-9V @ 200mA

- Polarity reversible
- 4-way connector

Ideal for all small electronic appliances — radios, calculators, toys, etc. Saves you a fortune in batteries in a short time. Value! Cat. M-9525

WAS $9.50 . . . NOW ONLY

$6.90

NEED MORE OOMPH?
This brilliant 3-6-9-12 volt power supply pushes out a massive 1 amp — ideal for all those high current applications such as burglar alarms, larger toys, cassette recorders, etc. Screw terminals, so you can use on just about anything. (Note: NOT a plug-pack)

$22.50 Cat M-9530

NEW! BY POPULAR DEMAND: VHF/AM 'COMMUNICATOR' RADIO

Remember the old VHF communicator radio? We sold thousands! Now, by popular request, here is a new VHF radio: The Communicator II.

Cat D-2833

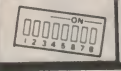
Listen to the exciting world of VHF. Aircraft, amateurs, business radio, etc – even the sound signal from TV stations.

INCREDIBLE VALUE:

$59.00 –still at the old price!

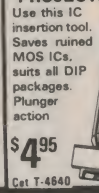
Exclusive! Thick webbed shoulder strap for comfort. Handsome military look case. Multi-section telescopic aerial adjusts for both vertical and horizontal polarization.
COVERS THE FOLLOWING:
AM (530-1600kHz) TV 1 (54-88MHz) FM (88-108MHz) AIR (108-136MHz) PB (135-174MHz) and CB (27-27.455MHz)

MINI DIP SWITCH
Ideal for use on PCBs, use for computers, etc. 8 SPST switches in one DIP package. Cat S-1608 **$2.75**



BUILDING IC PROJECTS?
Use this IC insertion tool. Saves ruined MOS ICs, suits all DIP packages. Plunger action

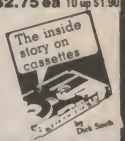
$4.95 Cat T-4640



QUALITY TAPE!
Try it: you'll be surprised at the high quality for the low price!

C-60LN: Cat C-3350 **$1.50 ea** (10 up $1.00)
C-90LN: Cat C-3352 **$2.00 ea** (10 up $1.20)
C-90EOR Cat C-3354 **$2.75 ea** 10 up $1.90

SPECIAL:
Buy 10 tapes, mixed if you wish, and get our bonus book, Inside Story on Cassettes as well as discount prices above!



NEW! IDEAL FOR THE EXPERIMENTER

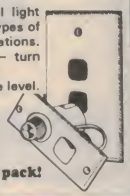
How many times have you been working on a circuit and needed a specific resistor? Our new resistance wheel, dials up the value you want! The handiest thing in your workshop or toolbox!

5 ohms to 1 megohm in 38 steps

Cat Q-1410 **$5.95**

IN THE MOOD!

Here's value: easy-to-install light dimmer supplied with two types of architrave plate: suits all locations. Full instructions provided – turn your harsh lights into soft mood lights . . . you pick the level. ONLY:



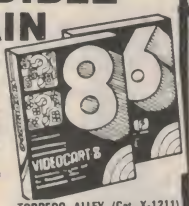
$6.90

Look for the bright new pack!
Cat X-1112

DEAR CUSTOMERS . . .
Quite often, products we advertise are completely sold out within a few days. Or problems may hold up delivery of promised goods so they are not in the stores when the advert appears. Please don't blame the store manager or staff: they are powerless to do anything about it! What we are trying to say is that, if you are about to drive across town to pick up a particular line, give the store a ring first . . . just in case!
Dick Smith and Staff

INCREDIBLE BARGAIN

Do you own a Fairchild Channel F video entertainment centre? Here's your chance to save a fortune. Dick's huge bulk buying has enabled prices to be drastically slashed on some cartridges. Buy now and save a fortune!!!
(NB: not all cartridges are reduced. See list below!)



BLACKJACK (Cat X-1201) TORPEDO ALLEY (Cat X-1211)
DESERT FOX (Cat X-1203) MAGIC NUMBERS (Cat X-1210)
ALL ABOVE NOW ONLY $5.00 EACH!

OTHER CARTRIDGES AVAILABLE:
Maze (Cat X-1204); Spitfire (Cat X-1206); Space War (Cat X-1207); Math Quiz 1 (Cat X-1208); Math Quiz 11 (Cat X-1209); Backgammon/Acey Ducey (Cat X-1213); Baseball (Cat X-1205); Sonar Search (Cat X-1214); Memory Match (Cat X-1215); Dodge-it (Cat X-1216); Pinball (Cat X-1217); Hangmen (Cat X-1218); Bowling (Cat X-1221). ALL $24.50 EACH

AUTO 24 TUNE 'BELL'

Remember the 'Chromechime'. We sold thousands! Here is a fully built up version of this popular circuit. 24 tunes, fully selectable. Comes complete with push-button for external mounting; so you don't have to buy one! Smart wood grain finish, ideal for mounting on or near door. Incredible value at our super introductory price:

$35 Cat X-1130

(The Chromechime was $49.50, in KIT form, and without a front door push button! Incredible!!!!).

WE'RE CHEAPEST!

YES! Compare our prices for zener diodes with anone else. You'll find we're cheaper by far – and you don't have to buy large quantities or special packs to get bargain prices from Dick Smith Electronics.

HI FI IN MINI!

Don't let looks deceive you! These superb hi-fi speakers may only be 120 x 120 x 190mm – but they've got the performance of enclosures many times the size! Ideal for caravan or car, flat, etc. where space is limited. Try them! Cat A-2375

$99.50 pr
Your ears will say 'Thank You . . .'

HIDE IT!

SPEAKER COVER

$2.75 Cat C-2646

This one's for the tradesman and hobbyist. Installing intercoms, PA, background music, etc – use these flush-mounting speaker grilles. Great value, makes a neat job!

FIX A MIC OR MAKE A BUG
Microphone crook? Fix it with our elect. mic. inserts. They're great value! Or make a bug: they're tiny, and come with data.

1.95 Cat C-1160

BUDGET SWITCH PACK
Pack of 4 push button switches; col. tops for easy identification. Four colours available.

Cat S-1200

$2.50 (Pack of 4)

A $199.50 CB FOR ONLY $99.50????

Yes, the mighty Midland 886 base/mobile is sacrificed at less than half price! 240 volt or 12 volt operation, deluxe set with phone and/or speaker. Save $100 by buying NOW – but be quick! While they last: Cat D-1438

$99.50!!!!!

Here it is! TI's superb TI58C prog.

Up to 480 program steps or up to 60 memories! Complete program editing features; up to 6 levels of sub-routine. And it has the constant memory™ feature. Retains information when turned off – you don't lose valuable information.
Incredibly versatile instrument – call in and check it out! Cat Q-3705

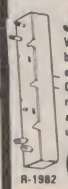
ONLY...$165.00..

$18.00 WORTH OF SOFTWARE FREE!!
With each TI58C sold by Dick Smith Electronics, Texas Instruments will send, free of charge, two software 'Pakettes' of your choice (see list). Normally $9.00 each, yours FREE! (Coupon included with each TI58C)

THE PAKETTES AVAILABLE (only from Texas Instruments!):
Electronic Engineering; Civil Engineering; Mathematics; Marketing/Sales; Fluid Dynamics; Statistical Testing; Securities; Oil/Gas/Energy; Blackbody; Astrology; 3D graphics; Production Planning.

MORE OF DICK'S BONZA BULK BUY BARGAINS – BEWDY!

Just a few left . . .
We've been swamped by the response to our 'bonza bulk buy' offers. And these 50k slider pots are no exception. If you want any, grab 'em quick!
Quality 50k sliders from major manufacturer, at a crazy low price – way under normal retail!



R-1982

60¢

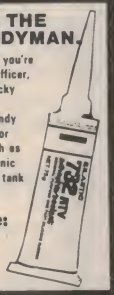
BIG QUANTITIES
Interested in buying (or selling) big quantities of 'bonza bulk buy' lines such as we show here? Talk to our marketing manager – Phone (02) **888 3200**

FERRITE RODS:
How's this one – 194 x 9mm ferrite rods normally sell for $2.00 or more. Our normal retail price is $1.50. But as a bonza bulk buy for a short time only: **90 cents!** Yes, way under price, with dozens of uses for the electronics hobbyist: aerials, chokes, filters, audio supressor circuits, etc, etc. While our super special lasts; first come first served. Don't miss out on this one!

Cat L-1401 **90¢ ea!!!**

NEW! FOR THE HANDYMAN.

If your name is Adam and you're a Dick Smith purchasing officer, you'd describe this as 'sticky water proofing stuff'.
To anyone else, this is handy 'silicone sealant' – ideal for any waterproofing job such as antenna insulating, electronic ignition sealing, even fish tank making! Cat N-1225



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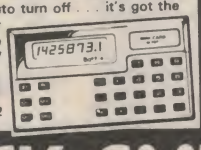

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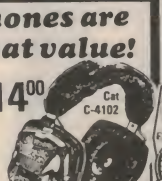

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Jupiter revisited

In our June issue, Brian Dance reported on the Voyager 1 encounter with Jupiter and its moons. In this article he tells us about the Voyager 2 encounter with the Jovian system and further discusses some of the results obtained from these missions.

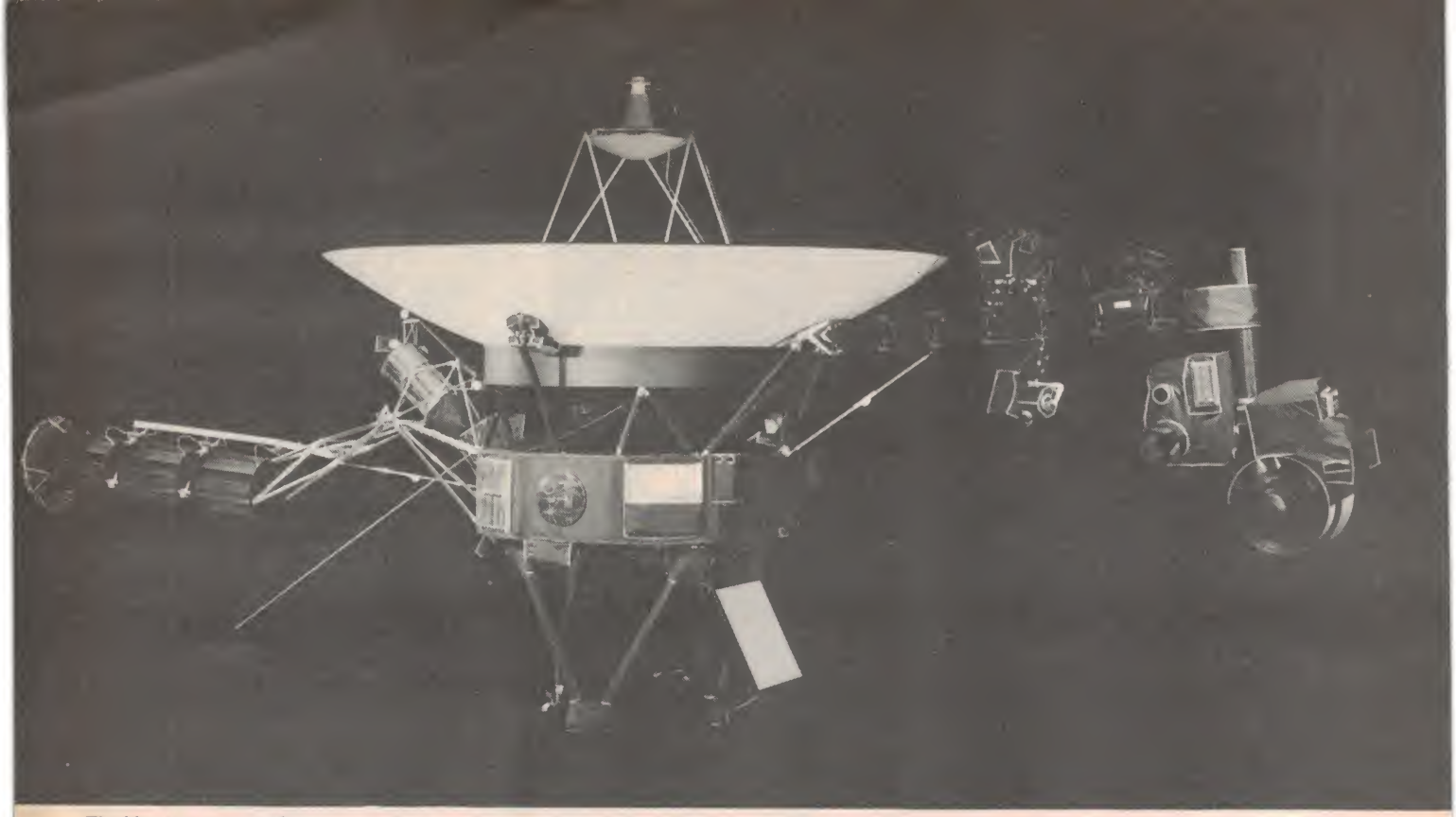
Europa, one of Jupiter's moons. The complex patterns seem to indicate that the icy surface has fractured, the cracks filling with dark material.

1979 WAS A MAGNIFICENT YEAR for inter-planetary exploration. Early in the year the Pioneer Orbiter spacecraft sent radar images of a huge rift valley hidden beneath the Venusian clouds. Shortly afterwards Voyager 1 sent back excellent images of Jupiter and its satellites; its sister spacecraft, Voyager 2, has now also sent us really first class images from somewhat different viewpoints. Even as I write this in England, Pioneer II is sending us the first ever close up images of the beautiful planet Saturn, its ring system and its moons. We have now obtained close up views of all of the planets from Venus to Saturn and the scientists are overjoyed by their excellent quality — a truly magnificent achievement in such a short space of time!

Brief history

Exploration of the outer planets commenced with the Pioneer 10 and Pioneer II spacecraft — the first craft to go beyond the asteroid belt. Pioneer 10, launched in March 1972, came within 131 000 km of the cloud tops of Jupiter in December 1973 and crossed the orbit of Saturn in 1976 and the orbit of Uranus in 1979. It will leave the solar system in 1987, heading in the general direction of the red star Aldebaran in the constellation of Taurus.

Pioneer II, launched in April 1973, sent us much better images of Jupiter from a distance of 42 000 km in December 1974. However, even a casual glance at these Pioneer II photographs immediately indicates that they do not even approach the high resolution ▶



The Voyager spacecraft.

photographs returned to Earth by the two larger Voyager spacecraft with their 3.7 metre diameter parabolic antennae and improved equipment.

Voyager I, launched on 5th September 1977, passed within 348 890 km of Jupiter on 5 March 1979 (see ETI, June 1979) and is now moving towards a Saturn encounter in November 1980. Voyager 2, launched 16 days earlier on 20 August 1977, followed a lower velocity trajectory to a Jupiter encounter on 9 July 1979 at a distance of 643 000 km.

There are intense radiation belts surrounding Jupiter (similar to, but far more intense than the Van Allen belts surrounding the Earth) owing to the magnetic field of Jupiter which is some 20 to 30 times that of the Earth's magnetic field. The semiconductor devices in Voyager 2 suffered less radiation damage than those in Voyager 1, since Voyager 2 did not come so close to the planet.

Voyager 2 is now on its way to a Saturn encounter on 27 August 1981. It seems virtually certain that the controllers of this spacecraft will take the option of sending it for an encounter with Uranus in January 1986 and for an encounter with Neptune in September 1989 unless some unexpected malfunction should occur in the spacecraft. Finally it will leave the solar system roughly in the opposite direction to Voyager 1.

Apart from the encounters themselves, when activity at the ground stations and mission control is at its maximum, all of the spacecraft continue to return valuable data about the interplanetary space through which they are passing. Radio communication will eventually be lost with each craft when it is no longer possible to send a command signal which causes the spacecraft antenna reflector to be directed towards the Earth. Unfortunately the inevitable delay in communications becomes greater as one uses spacecraft at ever increasing distances. At the Pioneer II Saturn encounter the delay is some 1 hour 25 minutes, so if one sends a signal to the craft, it will be 2 hours and 50 minutes before any response can be obtained even if the craft immediately transmits the responding signal. In such a time a spacecraft travelling at speeds of perhaps 100 000 km per hour can travel an enormous distance. Mission control expects to know the position of any spacecraft to within about 10 km at all times.

Voyager 2 craft

Some of the principal work of Voyager 2 (like that of Voyager 1) concerned studies of Jupiter's atmosphere, its composition and dynamics (including the Great Red Spot which has fascinated astronomers for many years), magnetospheric effects, the newly discovered rings around the planet and a comparative study of its fascinating satellites. Images were obtained at wavelengths from the infra-red through the visible to the far ultra-violet. In addition, radio emissions from the planet were studied.

In the period between the arrival of the Voyager 1 and the Voyager 2 spacecraft, the Great Red Spot moved somewhat towards the West and the White Ovals towards the East. Time lapse photography of the Great Red Spot has shown that its surrounding features circle the Spot in a period of some six days at a speed of the order of 400 km per hour. Voyager 2 images showed a white cloud circling the Great Red Spot which was not present in the Voyager 1 images.

It is known that the gas phosphine (a compound of phosphorous and hydrogen) is present in the Jovian atmosphere well below the cloud tops and it seems likely that the Great Red Spot consists partly of red phosphorus produced by the photolytic decomposition of the phosphine by sunlight where the gas has been brought to the top of the clouds. It has been shown that ultra-violet irradiation of phosphine will produce red phosphorus in earth laboratory experiments.

At ultra-violet wavelengths, the Great Red Spot is quite dark whereas the white ovals are bright. The enormous Red Spot is some 21 000 km by 10 000 km in size – somewhat smaller than it was 10 years ago. The atmosphere of the planet is cooler above the Great Red Spot than at other places.

This Great Red Spot was seen over 300 years ago and undergoes a kind of anticyclonic rotation. It is not clear as to whether the Great Red Spot seen by

Cassini in 1664 is the same Red Spot we see nowadays. There are also a number of transient small red spots which interact with both the Great Red Spot and with each other. The Red Spot is a whirling storm.

Jupiter is gaseous and does not have a definite surface (as far as is known) like that of the planets Mercury, Venus, Earth or Mars, but is essentially a ball of hydrogen gas with some helium. It has a diameter about 11 times that of the earth with the relatively short rotation period of about 10 hours. The mean density of Jupiter is only about 1.3 $g.cm^{-3}$ of the Earth. Nevertheless most of the mass of the solar system other than that in the sun is present in Jupiter.

The maximum temperature on Jupiter is believed to be about 260 K (-13°C). It has been known for some time that Jupiter emits twice the amount of heat it receives from the Sun, but the intensity of sunlight is only about 1/25 of that at the Earth. Some scientists believe that the internal heat of Jupiter is "fossil heat" left over after the formation of the planets and is now leaking out from the deep interior. This heat, combined with the high speed of rotation, drives its weather pattern.

The rings

One of the surprising phenomena discovered by Voyager 1 was a ring around the planet somewhat like the rings of Saturn, but barely visible until an image is obtained from near the planet.

The Voyager 2 photographs showed the ring around Jupiter very clearly; it extends from 120 000 km above the clouds right down to them (unlike Saturn's rings which do not extend to the cloud surface). The material of the rings does not seem to be from the planet itself. Uranus also has rings.

Jovian satellites

Jupiter has 13 known moons including the four large ones discovered by Galileo; we still use the names he gave them. The nearest Galilean satellite to Jupiter is Io which has a diameter of 3636 km and orbits at a distance of 5.9 Jupiter radii. Europa is 3066 km diameter and is at 9.4 Jupiter radii, Ganymede 5270 km diameter at 14.99 Jupiter radii and Callisto 4890 km diameter at 26.33 Jupiter radii. The sizes of these four satellites are comparable to that of the Earth's moon (3475 km diameter) and the planet Mercury (4880 km diameter). Jupiter's equatorial diameter is 142 796 km.

Most of the other satellites of Jupiter are believed to be captured asteroids.

Ganymede, Jupiter's largest satellite, photographed from a distance of 1.2 million kilometres. This moon has a thick, icy crust, the markings shown are both internal and external features.

Far more is known about the four large satellites than about any other satellites except our moon and they are rather interesting bodies.

Voyager 1 returned excellent images of Io, Ganymede and Callisto (ETI, June 1979), but its nearest approach to Europa was a distance of 733 760 km. Voyager 2 remained outside the orbit of Europa and also returned. good images, although it did not come near to Io.

Io is one of the most fascinating objects in the solar system. It shows the greatest volcanic activity of any object with plumes extending up to 270 km above the surface and eruption velocities of 1 km sec^{-1}. Voyager 1 detected eight volcanic eruptions and Voyager 2 found 7 eruptions on this satellite, whereas it is most unlikely that a passing spacecraft would detect even one volcano on the Earth at any one time. Indeed, Io's volcanic activity is perhaps the most striking discovery of the whole Voyager Jupiter encounter.

Volcanic activity of this order requires a great deal of internal heating. Calculations indicated that the proportion of radioisotopes in the material of this satellite which would be required to maintain such a high internal temperature for volcanic activity over geological time would be very large in such a small body, so this indicates that another internal heating mechanism is present. The intense gravitational field of Jupiter produces tidal heating of Io as Europa and Ganymede produce changes in the distance of Io from the planet. This effect causes variations in the amplitude of large tides formed as Io rotates around Jupiter to which it always presents the same face.

Voyager 2 identified one volcano on Io which had also been detected by Voyager 1 some months previously, so some volcanoes may well be in a state of continuous eruption. The gases evolved are apparently mainly sulphur and sulphur compounds which condense to fine particles on the cold surface. As the surface of Io is renewed about every ten million years, no craters are seen.

An electrical current of some five million amps flows in a magnetic flux tube linking Io with Jupiter. A toroidal ring of plasma (ionised gas) surrounds Jupiter at a distance of the orbit of Io. Extreme ultra-violet studies have shown that this torus contains sulphur and other ions with an electron temperature of 100 000K. Particles of energy at least 7 MeV are trapped inside the torus. These effects are produced by the relative motion of Io and the Jovian magnetosphere. A power dissipation of the order of a million megawatts is implied in this system.

Europa

Voyager 2 came nearer to Europa than Voyager 1 and produced images with eight times better resolution. The surface of Europa contains few features suggesting major impacts and rays from craters are absent (unlike the Ganymede and Callisto surfaces). Tidal heating in Europa has been estimated as being about ten times less than that in Io, but Europa may show internal activity. It has been estimated that as much as 20% of Europa is water and it may be covered with a 100 km thick shell of water-ice. Europa has a very smooth surface with few cracks which can only be explained by ice flow, since gravity is ten times weaker than on Io.

Ganymede is the largest satellite of ▶

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A composite photograph taken from deep in Jupiter's shadow showing the thin ring of particles discovered by Voyager 1. The ring is unusually bright owing to forward scattering of light and a brilliant halo is formed around the planet by its atmosphere.

Jupiter which has a surface containing light and dark regions which indicate past earthquakes (or rather, "Ganymedequakes"). Voyager 2 provided high resolution coverage of both the hemispheres of Ganymede and Callisto which were not observed during the Voyager 1 encounter. The densities of both satellites indicate a high percentage of water.

It is interesting to note that the density of the satellites decreases as one moves out from the centre of the system. The values are Io: 3.53, Europa: 3.03, Ganymede: 1.93 and Callisto: 1.79 $g.cm^{-3}$. This may be compared with the decreasing densities of the planets as one moves out from the sun through the solar system.

Radio astronomy

Jupiter is the most intense source of radio noise reaching the Earth except for the sun. Its radio signals were detected in the 1950s, indicating that Jupiter had a strong magnetic field, but the detailed mechanisms by which the radio emissions were generated were unknown. The Voyager craft therefore carried low frequency radio receivers so that the radio emissions could be examined as the craft approached the system.

The receivers are superhet types which step in frequency in two bands. The high frequency band extends from 1.2 MHz to 40.5 MHz and the low frequency band covers 1.2 kHz to 1.3 MHz, the IF bandwidths being 200 kHz and 1 kHz respectively. Each step alternates between left and right hand polarisation. In the high frequency band arcs of noise were found to be present on a frequency-time plot which had not been observed from Earth owing to the interfering signals present in the region below 20-25 MHz.

A few months before the encounter date a new type of radio emission was detected from Jupiter (normally in the kilometric band) which often persisted for over an hour over bandwidths of a few hundred kilohertz. These storm-like noises were found mainly in the region of 200° longtitude and will be examined for possible correlation with Jovian lightning; they do not seem to be related to the position of Io. The plasma torus is a likely source of these emissions.

Telecommunications

The outstanding success of the Voyager missions has been made possible only by the availability of the highly developed US Deep Space Network (discussed in detail in ETI, July 1978). The Voyager craft transmitted with power levels between 10 W and 30 W producing a signal level at the Earth of some $10^{-18} W.m^{-2}$, yet its signals were reliably received at almost all times.

Naturally, there were some occasions when the system did not work quite as well as expected (such as when some photographs were lost due to rain near the Canberra receiving station causing communications problems), but the performance generally exceeded expectations. There has been a steady improvement in the working of the Deep Space Network over the past 15 years. The present system is said to be about 150 000 times better than that used in the 1965 Mariner mission to Mars as regards communications facilities.

This improvement is partly due to batter spacecraft design. The Voyager craft returned images at a maximum rate of one image in 48 seconds, each picture consisting of 800 x 800 picture elements (or 'pixels'), an eight bit binary number indicating the intensity level of the picture at each point. Each craft returned nearly 20 000 images from the region of Jupiter. The maximum data rate for imaging was about 107 000 bits per second, whilst non-imaging science required data rates of up to 3560 bits per second, engineering data only 40 bits per second. Much lower data rates were used when the craft were well away from Jupiter.

As the craft approached Jupiter, a point was reached about 12 days before the time of closest approach when it was no longer possible for the imaging systems to produce an image of the complete planet. The imaging cameras therefore had to be targeted at specific points on the planet or its moons. Decisions as to which region was to be examined at any moment had to be made 30 days earlier so that the required command signals were in the memory. This required some very careful forecasting of the Jovian weather and an allowance for a longitudinal drift varying from -3° to +10° per day, but most features were seen at the time desired. (This makes one wish our weather forecasters could produce equally good Earth forecasts!)

The 64 metre antennae of the Deep Space Network are able to coherently track signals as weak as $4 \times 10^{-21} W$ (0.004 attowatt) which is said to be about 100 million times more sensitive than a domestic television receiver. After amplification by a low temperature maser, the signals from the Voyager craft are fed to a phase locked loop circuit which can track the frequency of the signal in the presence of noise. If the Earth antenna is mis-directed by only 0.02°, half of the power of an incoming X band signal can be lost. After detection, a phase locked loop circuit is again used to track the sub-carrier containing the telemetry data. The data is then processed by computer.

Performance

Much more detailed information on Jupiter encounters appeared in the Journal *Science* (available as a reprinted book from American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, DC 20005).

The Voyager missions have offered us the opportunity of sending spacecraft not only to Jupiter, but also to Saturn, Uranus and Neptune in what is known as "The Grand Tour".

This has been possible only because of the particular alignment of the planets about this time and this alignment occurs about once in 169 years. Therefore it was an opportunity we could not afford to miss, since the cost of sending separate spacecraft to each planet is very large. Think of the two Voyager craft as you look towards Jupiter or Saturn on a starry night!

The author wishes to thank Don Bane, Public Information Office, The Jet Propulsion Laboratory, California Institute of Technology for the excellent photographs and detailed information about the Voyager 1 and 2 missions.

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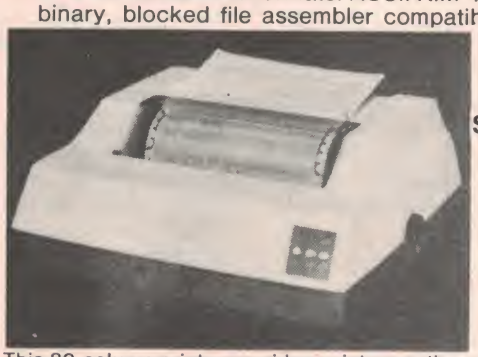

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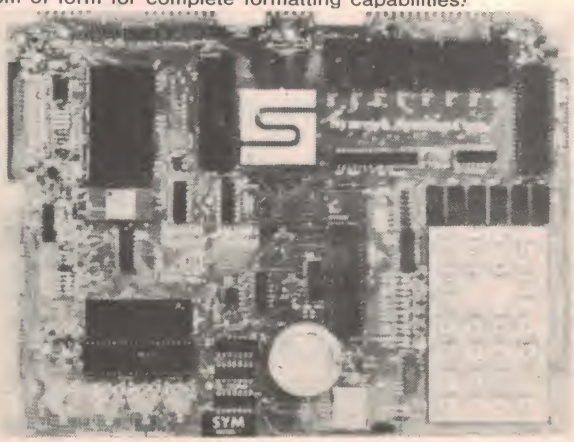

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Small computers market guide

Now that the initial flush of activity has subsided and the local and international industries have sorted themselves out appropriate niches in the market place, it seems about the right time to present a guide to the "plug-in-and-go" systems being offered here.

SINCE WE PUBLISHED our very popular Personal Computing special feature in June last year, we have had a gradually increasing number of enquiries from readers, and from people referred to us by readers, about "plug-in-and-go" type small computers. While it seems that many readers with a hobby interest in computing are hardware or hardware/software oriented, it seems there are many others out there who are looking towards small computers or 'home' computers of the plug-in-and-go variety to solve particular problems. Looking at it another way, it seems from the general trend of enquiries over the past six months that there are many people looking at small computers as a tool – a means of assisting a particular job or task.

As a means of assisting these people, this market guide presents details of the ready-to-go machines currently being offered in Australia.

In browsing around the market, it is a wise idea to keep your application(s) foremost in your mind – and your priorities. Is speed or large-capacity storage a prime requirement? Do you need more than one terminal? What sort of software is applicable to your task? In general, you will find suppliers quite helpful with advice. A succeeding article in this issue covers the area of peripherals – printers, floppy disks, memory expansion etc.

ALTOS, SERIES 8000:

The US-based Altos Computer Systems Company offers a range of professional-grade systems generally aimed at business and scientific applications.

Their basic machine is the ACS 8000 which comes complete with 32K of RAM, and two 210 mm floppy disk drives. Terminals have to be acquired as an extra item and Altos have a range of various models to suit. The system is supported by a powerful software package which includes extended business BASIC, CBASIC2, PASCAL, COBOL, a FORTRAN IV compiler, a macro-assembler and CP/M disk operating system to boot. You can start looking for around $5000.

The Altos range, and peripherals, is distributed here by the Dindima Group, P.O. Box 106, Vermont Vic 3133; (03) 873-4455.

APPLE:

From the Apple Computer Company in California – the basic machine has been upgraded from time to time since its introduction a few years ago, the latest being designated the Apple II Plus.

The basic machine is a flat package, a little larger than a desk typewriter in width, incorporating a 53-key standard ASCII keyboard. It includes an output connection so that you may plug the unit into a standard TV receiver to serve as a VDU, or for a standard video monitor. Interestingly, it comes with colour video circuitry so that colour graphics may be displayed – a feature now being incorporated on many of the newer machines. There is a built-in loudspeaker for audio 'prompts' and signals and eight slots to accept various hardware expansion options. These include additional RAM allowing expansion to 48K, single or multiple floppy disk drives, serial and parallel interface cards for various high-speed printers, and there's also a special graphics input tablet and a voice recognition module.

This latest Apple includes 16K of RAM as well as a 10K Applesoft Extended Basic interpreter (resident in ROM) and a 2K monitor program. Additionally, you can get a plug in card with UCSD PASCAL interpreter in ROM to run programs in PASCAL.

Software for educational, business and professional applications is available.

You can start looking at the basic Apple for around $1600, plus TV or video monitor (black & white or colour, depending on your application) and other peripherals. You can even get joysticks for games!

The Apple and accessories are marketed by Computerland Australia Pty Ltd, head office is at 55 Clarence St, Sydney 2000; (02) 29-3753

COMMODORE, PET & CBM:

Commodore's PET is your archetypal plug-in-and-go machine. Commodore Business Machines, another US-based company, produce two rather similar-looking machines. Their PET is the 'down market' model – a 'home' or hobby computer (but considerably more than an expensive 'toy'), but a formidable machine nonetheless.

The basic PET comes complete with in-built monochrome monitor with a 230 mm screen, and a cassette tape deck. The somewhat unorthodox keyboard, with its tiny, calculator-like keys, contains 73 keys laid out a little differently to a typewriter. You get used to it though, so we are told.

On-board software includes a fairly powerful BASIC interpreter (8K) in ROM and 6K of monitor program. There's 8K of RAM for you to use, which can be expanded by a further 40K with an extra expansion kit.

There's plenty of software around for the little PET, ranging from cerebral games to hard-nosed business. The 8K PET is available for around $1500.

The CBM 2001 SERIES is Commodore's 'up-market' machine designed principally for business and other professional uses. It looks much the same as the PET, but has a conventional keyboard, with additional operating keys. It comes with either 16K or 32K of RAM and 14K ROM (operating system in residence), 8K+ BASIC interpreter, 4K operating system and 1K machine language monitor. The in-built 230 mm monochrome VDU is the same as the PET's. The keyboard can be obtained in two versions – number pad or business.

The input/output is through a IEEE-488 bus for instrument interface or multiple intelligent peripherals, according to Commodore.

Peripherals available include a dual-drive 210 mm floppy disk pack (model 2040) and a tractor-feed printer (model 2022). There is also a friction-feed printer, model 2023.

The 16K CBM will set you back about $1800, about $2200 for the 32K version. The floppy disk pack costs around $1700 while the tractor-feed printer is priced around $1800. The friction-feed printer is a little cheaper at around $1500.

Hanimex handle the Commodores. Their head office is at 108 Old Pittwater Rd, Brookvale, NSW.

COMPUCOLOUR II:

Called "The Renaissance Machine" in the advertising blurb, this machine is unique in that it includes a mini-floppy disk drive ('diskette') for data and high-speed program storage along with a 300 mm colour video monitor.

The Compucolour is a stand-alone machine. It incorporates 32K of user RAM, 16K BASIC interpreter and a monitor in ROM, CRT control software and a file

management system. Video software includes bar graph drawing capability and the VDU is a 32 line/64 character type – fairly standard, with double height/double width capability. You can get eight foreground and eight background colours on the display. For peripherals an RS232 port and bus expansion are provided as standard.

The Compucolour II 'Sof-Disk' library of mini-floppy includes a sampler disk as a 'demonstrator', six games, income tax, assembler (8080), text editor, personal data base and four statistics disks.

The basic Compucolour comes with quite a simple instruction manual, aimed at the raw beginner, for around $1900 from Anderson Digital Equipment Pty Ltd, P.O. Box 322, Mount Waverley, Vic; (03) 553-2077 or P.O. Box 294, Ryde NSW; (02) 808-1444.

CENTURY:

Century systems are very new to the Australian market, there are three systems being offered: the C100, C200 and C300 ranging in price from about $5000 to $15 000.

The C100 comes with 78-key keyboard, 48K of RAM, two floppies with 143K capacity each, one RS232 port, one parallel printer port, an S-100 edge connector, a printer and a VDU. All for $4950.

The C200 is similar but has 64K of RAM, two 315K floppies, four RS232 ports and two parallel ports plus hard disk capability and multi-user/multi-tasking; from $5400.

The C300 is a multi-processor machine (with seven micros!), 104K of RAM expandable to 1M, direct memory access, 1M of floppy disk capacity, four RS232 ports and it will interface with up to 24 VDUs. There is also hard disk facility with up to 600M of memory available plus multi-user/multi-tasking facility. That's the top of the line – $14 500.

The following business software is available: debtors, creditors, general ledger, stock control, invoicing and word processing.

Century computers are sold here by the Abacus Computer Store, 512 Bridge Rd, Richmond 3121 Vic; (03) 429-5844.

EXIDY SORCERER:

Another machine out of California, by Exidy Inc., the basic machine has an in-built keyboard (standard ASCII) that includes a numeric keypad as well (total of 79 keys if you want to count them). A video monitor must be obtained separately, or you can hook it up to a modified TV set. You can connect one or two cassette recorders for program and data storage and there are parallel and serial ports for various peripherals (printers, disks etc).

The basic machine comes in two versions: with either 8K or 16K of user RAM. It has a 4K monitor program in ROM and is supplied with a 4K "ROM PAC" that plugs into the side of the case. This contains a standard 8K BASIC interpreter. You can also get other ROM PACs with a word processor program and one with an assembly language development package. One thing not generally available is a user-programmable EPROM PAC.

Although software was initially rather limited, the situation is gradually improving.

A 'bare bones' Sorcerer will deplete your bank balance by about $1100 for the 8K version, $1250 for the 16K. Video monitor and cassette tape decks extra.

Peripherals are available to go with the machine, the usual disk drives (including a quad-density dual), printers and an S-100 Bus expansion unit.

You can check out the Sorcerer's magic at Dick Smith stores.

MICROCON:

This machine is somewhat out on a limb. Basically, it's a microprocessor-based 'universal' controller. Its main function in life is to run, or control, some piece of equipment or operation (or several!), carrying out a predetermined sequence of events. It also has great potential as a learning aid.

The basic idea behind it is that there are a great many applications where one does not require the full power of a fast MPU. A machine with a full ASCII keyboard, VDU and etcs would be cracking the acorn with a sledgehammer – so to speak. That's where the MicroCon comes in.

It is available in several versions, from a single board and panel to a plug-in-power-and-attachment stand-alone machine.

The front panel consists of a keypad and a four-digit, seven-segment display. It has a number of input/output ports which attach to external equipment to provide data in and control signals out. There are eight in all (8 in, 8 out), each being TTL-level compatible.

Once you have a working program you can have a PROM blown and inserted into a socket provided on the board, thus getting a 'resident' program 'dedicating' the system to a particular task.

The system as it comes includes 1K of PROM, 1K of RAM (of which ½K is available to the user, but there are two sockets to take 2114 RAM chips which are also user-accessible, bringing the system up to 1½K). Sufficient decoding is provided for the I/O ports, the keyboard and display plus the expansion port on the back of the board.

A range of 'expansion' peripherals are available, including 16-bit input and output, analogue/digital converters, serial I/O with RS232C etc.

The basic machine is the MC1, it sells for $200 tax paid. Other bits extra, but inexpensive. It comes complete with a very comprehensive, easy to use manual. We reviewed the machine in July, last year.

The MicroCon is made in Australia by MicroPro Design Pty Ltd, P.O. Box 153, North Sydney NSW 2060; (02) 438-1220.

OHIO, CHALLENGER SERIES:

Ohio Scientific Corporation make and market a range of machines pitched from the hobby level right up to the 'minis'.

The Challenger 1P has an ASCII keyboard, video interface (you provide the monitor), 4K of RAM and an 8K BASIC interpreter in ROM. That lot goes for around $500.

If you want to get into the big stuff, there's the Challenger III which comes with the usual keyboard plus dual 210 mm hard disks (that's about 70-odd megabytes of memory!) and RAM up to 48K bytes. The usual range of peripherals are also available (floppies, printers etc) and a wide range of powerful software applications.

There's obviously not enough space to go through the whole range here, but Ohio's latest, the C8P DF (see Sept. '79, p. 95.) comes with twin 210 mm floppies, has a 'mainframe' architecture (you can slot in some further boards for special applications) and includes 'home' peripherals that can look after details of running your house – so they say.

Prices for the Ohio series of machines range from $500 all the way up to $15 000 or so.

Ohio Scientific is represented in Australia by Systems Automation, 26 Clarke St, Crows Nest NSW 2065; (02) 439-6477.

PECOS:

The PeCos I is a stand-alone unit that includes a 230 mm monochrome VDU, two cassette decks and a 60-key keyboard. It comes with 16K of user RAM and a 24K PeCos interpreter (it uses its own language – derived from JOSS by the Rand Corporation, if that means anything to you).

The VDU displays 40 characters per line (it has upper and lower case) and fits 16 lines total on the screen.

Curiously, as it uses cassettes for program and data storage, it can address up to four cassette decks (including the two on the machine).

The PeCos I sells for around $1700. Available from Calculator Supermarket, 261 Elizabeth St, Melbourne Vic; (03) 67-7412.

SORD:

One of the few Japanese-produced systems on the market, the Sord M100 ACE-1 is much like run-of-the-mill machines, with a 76-key ASCII keyboard, cassette recorder and a 300 mm monochrome monitor. It has a single floppy disk drive, RS232C serial I/O and a parallel I/O port. Included for the games enthusiasts (it's marketed as a home computer) is an analogue converter and joystick and a two-octave music generator, including a speaker.

In the memory department, the Sord comes with 48K of user RAM and it has provision for 6K plug-in ROM packs. Language-wise it runs a powerful Level IV BASIC interpreter, loaded from disk, plus a handy FORTRAN-IV compiler and relocatable assembler on disk.

Applications software is predominantly business, and games and fairly limited, although this situation is likely to improve.

The ACE-1 basic system is priced well under $3000 and you can obtain more information from Mitsui and Co. Ltd, 140 William St, Melbourne Vic 3000.

SWTPC:

Cryptically known as "sweatpack" systems, there are a variety of machines put out by the Southwest Technical Products Corporation, ranging from hobby-type to professional level systems. For a plug-in-and-go machine, Southwest have the SWTPC/09 (6809), a system that teams together their basic twin-processor computer with a model CT-84 intelligent terminal (ASCII keyboard and 230 mm monochrome VDU with logic) and a model PR-80 bidirectional 80 column printer. This system has 56K of RAM and a disk system can be teamed with it to get a further 384K of memory. The basic system, 6809 plus CT-84 terminal, costs around $2500.

For something larger, the S/09 has 128K of RAM, dual 210 mm floppies, a 16 megabyte (!) hard disk and three terminals – for about $12 000.

Printers available for the SWTPC range from just under $1000 to $2500. ▶

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PHONE (03) 67-6412

Radio Parts Group, 562 Spencer St, Nth Melbourne. 329-7888, 1103 Dandenong Rd, East Malvern. 211-8122

SWTPC systems are distributed here by Paris Radio Electronics (trading as SWTP Australia) P.O. Box 380, Darlinghurst NSW 2010; (02) 31-3273. In Victoria, contact GFS Electronic Imports, 15 McKeon Rd, Mitcham Vic 3132; (02) 873-3939.

Software is available, varying from business to hobby, including some amateur radio applications.

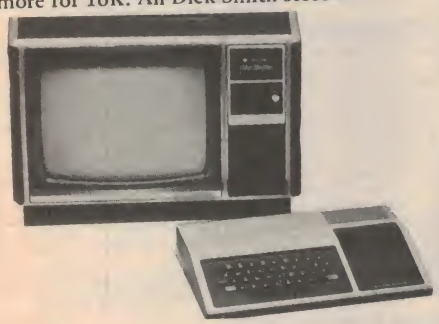
SYSTEM 80:

Few machines have been engineered to directly compete with another, but this one jumps on the TRS-80 (by Tandy) bandwagon to take advantage of the extensive software available for that machine.

Made in Hong Kong, for the ubiquitous Dic Smith Electronics, its major feature is compatibility with the TRS-80's Level II software. The basic machine has 4K of user RAM which may be expanded internally to 16K, a 12K Level II BASIC interpreter in ROM (and a monitor program, too) and a cassette recorder. The 'bare box' has a 51-key ASCII keyboard and is provided with both a direct video output and a modulator so that it can be plugged directly into a TV set. It has two video display formats, like the Level II Tandy, of 64 characters to 16 lines or 32 double-width characters (for better readability).

You can connect a second cassette recorder and a 48-pin expansion connector is also provided — an S-100 expansion unit can be obtained so you can plug-in the many S-100 based do-dads memory, voice recognition, etc).

Your bare bones System 80, sans video monitor, is around $600 with 4K, a little more for 16K. All Dick Smith stores.



TI-99/4

Texas Instuments' singing-dancing-talking computer for all seasons is due for release in the first quarter of this year.

From the information we have to hand, it seems the T199/4 was designed, and is to be marketed as, a home computer system. It appears to be a hybrid TV-game/computer (or vice-versa), designed with convenience and ease of use as primary considerations, rather than out and out computing power. It is supplied with a matching colour video monitor (largely to circumvent the US's FCC regulations on RF modulators). The keyboard is described as a "40-key staggered Qwerty" with overlay for second functions. you get 16K or RAM and 26K of ROM, the latter containing TI-BASIC. This is a 13-digit floating point ANSI-compatible BASIC, with special features and extensions for colour graphics and sound.

You'll be able to plug in a speech synthesizer (it uses their 'Speak-n-Spell' technology), with 250 words in the unit and the availability of plug-in vocabulary expansions.

Interfaces provided (apart from the video monitor) include two cassette decks, RS232, and a 44-pin peripheral connector (for up to three peripherals). Printer and disk units are planned.

Price of the TI-99/4 is expected to be around $1600.

TRS-80

Another example of your archetypal plug-in-and-go computer. The basic machine is a computer unit with keyboard (ASCII, 53 keys) and matching 300 mm monochrome video monitor, plus a cassette recorder. Video format is 64 characters to 16 lines, plus graphics in 128 x 48 point format. You can mix text and graphics.

Your most basic TRS-80 is Level 1 with 4K of user RAM and a BASIC interpreter in 4K of ROM — modest, but useful if you're not going to get in too deep. You can increase the capacity of adding more RAM, and/or going to the 12K BASIC in ROM.

The Level II machine is the same outwardly, but comes with the 12K BASIC in ROM and has 16K of RAM.

The only interfacing you get with either machine is for the cassette tape. There is an expansion connector that plugs into an optional expansion unit that has provision for interfacing up to four mini-floppy disk drives, a further 16K or 32K of RAM, dual cassette recorders, a real-time clock and an RS232C serial port.

Applications software is very wide-ranging, probably the best supported plug-in-and-go system. You can get everything from the usual games through to maths and business packages.

The 4K Level I machine is available for around $800 while the 16K Level II machine is nearer $1400. Tandy stores everywhere — peripherals too.

VECTOR GRAPHIC MZ:

Two business-oriented systems are made by the US-based Vector Graphic company under the 'MZ' banner — the 'System B' and the 'Memorite'. The System B is a small-business system for accounting and stock control applications while the Memorite is a word processor for document production etc.

System B has 48K of RAM and 12K of ROM (or EPROM if you want) and two, dual-density mini-floppy disk drives (giving a further 630K of memory). The basic computer is teamed with Vector Graphic's MT 'mindless terminal' — you can have up to five of them, in fact, hooked up to the one machine. The MT has a 300 mm VDU and keyboard a fairly standard arrangement but the 80 column by 24 line format is unusual. Software includes the popular and powerful CP/M disk operating system, MBASIC — a business language (obviously) and a program development system with assembler. Naturally a range of peripherals are available, including printers, hard disk system etc. Time sharing facilities is a recent addition. Start shopping around $6000 or so.

The Memorite word processing system has the same basic hardware as the System B but can be used with a Diablo or Qume printer to provide good quality copy suitable for photocopying or instant printing. The word processing software is contained in ROMs and the dual-floppy disks are used for data storage.

You type text on the MT's keyboard and it is displayed immediately on the screen and also put into memory. You can edit from the screen — and that's where the 80 column by 24 line VDU format comes in handy, and print at any time (as many times as you wish).

The Memorite basic system starts at around $10 000.

Vector Graphic systems are available from A.J. & J.W. Dicker, 24 Woodfield Boulevarde, Caringbah NSW; (02) 524-5683.

VERSATILE SYSTEMS.

A number of systems, ranging from $5000 upwards, are available in the Versatile range. Each includes an integral 230 mm monochrome VDU, dual 130 mm floppies, keyboard, and two serial (RS232) I/O ports — all in a desk-top cabinet.

Latest in the range is the model 3B which is aimed at small business applications for administrative and management information processing, bookkeeping, inventory control etc. The VDU format is 80 columns by 24 lines (one of few about) and the machine comes with 32K to 64K of RAM. The disk system provides 286K on-line storage and the interface can support two further dual-density disk drives for upto 572K of storage. The 3B comes with the Multi-Disk Operating System software, MDOS. Other software available includes CP/M and CBASIC. The 3B is priced at under $5000.

The Versatile 4 comes with 32K RAM and dual disk drives with 630K capacity, but is otherwise similar to the 3B. A 'Business Manager' system is based on this machine. With the addition of appropriate software and a printer, you get quite a powerful business applications system and word processor. Three printers are currently available — the Qume Sprint 5 daisy-wheel, the Texas Instruments TI180 dot matrix and the Integral Data Systems low-cost dot matrix range.

Available software for these systems includes Micropolis Disk Extended BASIC, Microsoft's Wordstar, amongst others. There is a full set of business software available to suit Australian businesses, similar to ranges offered by a number of firms.

Versatile systems are sold by Microprocessor Applications, Maskell's Hill Rd, Selby Vic 3159; (03) 754-5108. ●

A guide to peripherals for small computers

Now that you can walk into a store, lay down your money and walk away with a "plug-in-and-go" computer, the opportunity to do those tasks one only dreamed about a few short years ago is available right now. But, that computer might need a few adjuncts before you can proceed to realise your dream . . .

Les Bell

IT'S ALL VERY WELL having a computer with, say 32 Kbytes of RAM, a VDU and a cassette interface and being able to play Star Wars, but if you want to use your computer to do something sensible you have unfortunately got to spend some money on the peripherals to go with it.

A floppy disk for example, speeds up program development tremendously, and enables the maintenance of files of data that would be impossible on cassettes. A printer is virtually essential for the debugging of large programs, and there's no way you can print invoices without one. In this article we look at these two most important peripherals.

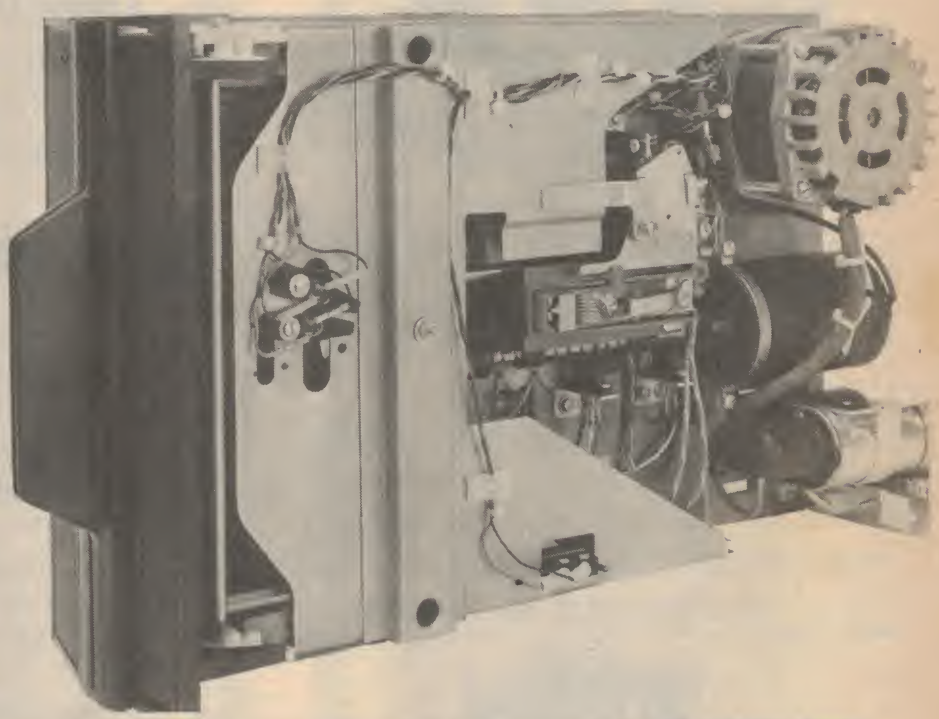
Floppy disks

As most computer hobbyists and professionals are aware, when it comes to mass storage of up to a couple of megabytes there's only one way to go and that's with floppy disks. Cassettes are incredibly slow and inconvenient, though cheap, and most people using them soon wish they had disk drives.

A floppy disk is a mylar disk covered with an oxide magnetic medium and enclosed in a square board jacket to protect it from damage in handling. There are several holes in the jacket to allow access to the magnetic surface: a large one in the centre where the inner disk can be gripped by the drive in order to rotate it, and a long slot radiating from the centre where the read/write head moves over the disk are the important ones.

Each floppy disk can in theory store up to around 2 megabytes of data. In practice, the capacity is held down to around 500 Kbytes in order to ensure reliability and compatability between drive-controller combinations.

The drive into which the disk is inserted is quite a fearsome mechanical monster, but its operation is basically quite simple. When the disk is inserted into the drive and the door closed it is seized rigidly, and a cone and flexible clutch grip the centre of the disk and start spinning it at 360 rpm, still inside its jacket. At the same time a lead screw mechanism positions a read/write head over the disk, and it is now ready to use. The head can move in and out over the surface of the disk to select any one of 77 tracks (numbered 0 to 76). Each track is divided up into 26 sectors (numbered 1 to 26) each of which can be identified by the controller.



Disk drives can make enormous improvements to memory capacity and speed of a system.

The motion of the read/write head, called seeking, is controlled by the computer through the disk controller circuitry. The head takes less than 10 ms to move from track to track, with an average seek time of less than 200 ms. Once the head is on the right track, and the required sector has come round, data transfer can take place at rates of up to 250 Kbits/s. So it's obvious that a floppy disk is much faster than a cassette.

In order to ensure that a disk written on one drive/controller combination can be read on another, the information on the disk is stored in a precise format. Three different schemes are used: hard sectoring, soft sectoring at single density and double-density soft sectoring. As the disk rotates, the control circuitry must be able to identify the beginning of each sector and which sector it is. On a hard-sectored disk this is achieved through 32 holes punched around the disk which physically identify the start of each of 32 sectors, plus another index hole which identifies the beginning of each revolution. On the drive, a lamp and phototransistor indicate when a hole is present and give and index pulse.

Soft-sectored disks, on the other ▶

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Twin floppy disk drive for Commodore's CBM system, sold here by Hanimex.

hand, use header information recorded ahead of the data to identify each sector and track as well as cyclic redundancy check codes (CRCCs) to identify errors on reading back data. The soft-sectored format allows records of any length, but in practice manufacturers tend to follow the two standards laid down by IBM for their 3740 data entry system and the System/34 computer system. The first uses a record length of 128 bytes (excluding the address header and CRCCs) and is recorded using a frequency modulation technique which records clock pulses in between each data bit. On a read, the disk controller has to separate the clock from the data, compare the CRCC it generates with that read from the disk, and supply the data to the computer, as well as flagging any errors.

The System/34 format uses a modified frequency modulation (MFM) format to write 256 byte records. In this double density mode the controller only writes a clock pulse to the disk between two zero bytes — otherwise just the data is written. This makes data separation a lot more difficult on reading back, but the increased storage is well worth it.

Controllers

The circuitry and hardware discussed so far has been inside the floppy disk drive itself, but a major and important part of the circuitry lives inside the computer — this is the controller board which forms the interface to the computer and performs various other functions.

Most floppy disk controller boards are based on the LSI controller chips that are now becoming available. Of course, each controller board suits a particular computer or bus structure, but the basics of controlling a disk are common between different computers and different disks and chips such as the Western Digital FD1771 or FD1791 will interface to just about any 8- or 16-bit micro.

Other Options

The use of double density recording gives a single disk a capacity of over 500 Kbytes. However, this can easily be doubled by using both sides of the disk in a double-sided drive. The only drawback with this is a reported increase in wear on the disk, although this should improve as manufacturers introduce design improvements.

The minifloppy is basically the same as the eight inch type, mechanically and electrically. However it rotates at only 300 rpm, has half the clock speed and uses a simpler spiral cam scheme to position the head. It is quite a bit slower than the full-size floppy in operation.

Software

In order to make proper use of a floppy disk, an essential piece of software is a disk operating system (DOS). This automatically looks after all transfers of data between the disk and memory, without the user having to keep track of details such as what tracks and sectors a file occupies.

For example, the DOS usually maintains a directory on the disk which lists all the files on it, where they are located, how big they are, what types of files they are, (text or object, etc.) and whether they are write-protected, all by name. In modifying say, a name and address file, a program would first *open* the file, which consists of locating it in the directory and setting up a file control block memory containing its parameters. It would then *read* the file, make the modifications, *write* it back to the disk, and then *close* the file, which means using the file control block to update the directory. Other functions of the DOS include killing files, reclaiming lost space by replacing the disk, copying entire disks from drive to drive, listing files to the console, and other tasks. Files are referred to by name, not by their location on the disk.

Several disk operating systems are available for different microcomputers and disk systems. The standard for 8080/8085/Z-80 based computers is CP/M, which was originally written to run on eight inch disks but is now available for five inch (127 mm) types as well. Processor Technology users can run the PTDOS system on the Helios drive, which is incredibly fast, using direct memory access to transfer data into the computer. Cromemco's CDOS is similar to CP/M, and software written for one will often run under the other. The same applies to Imsai's IMDOS. Many hobbyists have five inch disks and run the North Star DOS, which has somewhat simpler facilities than CP/M.

6800 users can choose between the Smoke Signal Broadcasting FLEX or the SWTPC DOS. Ohio Scientific have several DOSs for their range of machines, right up to a multi-user system on a 70 Mbyte hard disk. TRS-80s are backed by the Tandy TRS-DOS, while the Apple II has its own DOS.

The software supplied with a disk system is probably the major consideration when choosing a disk — electronically, most controllers and drives are practically identical. Micropolis, for example, supply their own MDOS operating system and Micropolis Disk BASIC, even though their disks can run CP/M.

CP/M itself is supplied with an assembler, text editor, dynamic debugger and utilities. Many other software suppliers, however, supply their wares on CP/M compatible disks, and many pieces of software require CP/M to be on the system in order to use its utility functions. There is also a CP/M users group, which allows cheap access to games and utilities as well as some nice software such as the languages STOIC and ALGOL.

Printers

When one wants to put a computer to serious use such as large program development, a printer of some sort becomes absolutely essential. Printers broadly fall into three categories (ignoring exotica such as ink-jet and electrostatic types): thermal and other non-impact types, dotmatrix impact, and conventional impact types.

The non-impact types all rely on some sort of special paper which is sensitive to heat or which can be altered by electric discharge. Thermal paper is widely used in portable printing calculators and can usually be recognised by a bluish-purple colour of print on white paper, with a complete absence of the embossing effect caused by the impact of a print head.

The characters printed by a thermal printer are usually formed from a dot-matrix; the print-head consists of a vertical column of seven or nine thick-film resistors on a ceramic substrate. As the head moves across the paper, the resistors are selectively energised to create heat, and the paper turns purple. Thermal printers are almost silent in operation and are extremely reliable due to their few moving parts. On the other hand, they are not very fast, the paper is more expensive than plain paper, and one cannot print multiple copies through carbon paper.

Electroconductive paper can easily be recognised by its metallic appearance; in fact, it consists of a layer of aluminium over black paper. Again, dot matrix character generation is used, this time with a column of small electrodes which dump about 30 V at around 30 A into the paper for a few ▶

microseconds. The aluminium burns away from under the activated electrodes, revealing the black paper underneath. The result is black printing on a silver background.

As with thermal printing, this is primarily an electronic process with very few moving parts, and so high reliability is achieved. The process is almost silent but again paper cost and the impossibility of printing copies directly make it unsuitable for a lot of commercial data processing work.

Impact Printers

Dot matrix character generation can also be used in impact printers. In this case ordinary paper, usually in rolls or fanfeed, is used with either a carbon or cloth ribbon.

The print head has seven solenoids mounted on a moving assembly. These solenoids punch seven vertically aligned hammers which are almost as small as needles, and these in turn press the ribbon against the paper. The whole assembly is quite simple and cheap.

The major drawback with this type of printer is the noise! As the printhead sweeps back and forth across the paper it makes an incredibly loud buzzing noise which seems to penetrate everywhere.

At the low cost end of this type of printer is the simple open mechanism with drive electronics, such as the South West Technical Products PR-40. This is a very simple mechanism, with the print head free to move in a groove in a large tube. As the tube rotates, so the print head is moved backwards and forwards across the paper, and by the use of some circuitry running off timing pulses from the tube, the solenoids are fired at the right time to create the characters.

A problem with these low-cost printers is that very often they only have 32 or 40 columns of characters. Standard commercial printing calls for a VDU and printer width of 80 characters (a carry-over from IBM 80-column punched cards). Many commercial printers are 132 characters wide.

The major objection to dot-matrix printers however, is the print quality. While 5x7 dot-matrix characters are legible, they are hardly elegant, and nowhere near as readable as typewritten characters. A variety of printers therefore work on the same principle as a typewriter; the characters are formed from metal or plastic and when these strike the ribbon an image is transferred to the paper.

The most common type of standard impact printer is the Teletype ASR33, in which a rotating barrel containing the print heads spins around, and the top head is struck from behind by the print hammer whenever the appropriate character occupies that position. The ASR33 is a mechanical nightmare to an electronics person, although their reliability is considerably higher than one might expect. The print quality of the ASR33 is not very good and it is very slow, normally 110 baud (10 cps).

Quality Printing

One of the best quality typewriters is of course, the IBM selectric golf ball typewriter. This uses a spherical high-impact plastic print element which has the fonts of the characters embossed on its surface. Wire cables control the rotation and tilting of the ball.

Versions of the Selectric were commonly used by IBM as computer consoles and they are often available second-hand. The problem is that these printers don't usually use the ASCII code, but rather the IBM Correspondence code or EBCDIC (Extended Binary Code for Data Interchange). Therefore your computer's printer driver routines will have to include a code conversion routine.

The Model 8300 dot matrix printer from Ampec Engineering is typical of 80-column printers and will print 60 lines per minute.

ASP Microcomputers are marketing a Selectric typewriter conversion kit which can be installed by the user and later removed to restore the typewriter to its original condition.

The Selectric provides quite high quality printing at a reasonable cost. Perhaps the best known type of general-purpose printer is the Centronics 700 series. Centronics printers usually interface through a parallel port with handshaking, what is generically known as a Centronics interface.

The Centronics printers don't quite provide letter-quality printing but they are reasonably fast, inexpensive and the quality is suitable for invoicing and general work such as program listings.

For the best quality printing in word processing and similar applications there are three well-known printers that between them have this market cornered. The best known is the Diablo 1355 printer, which uses a plastic or metal 'daisy wheel' to produce high quality printing in a variety of typefaces. This type of printer is microprocessor based, with a number of advanced features: for instance, the Diablo 1640 has a 256-byte print buffer (2304 bytes optional), can print up to 158 columns across the page, has variable column spacing with 120 positions per inch and adjustable left, right, top and bottom tabs.

Most of these printers can write bi-directionally; that is, as the print head returns to the beginning of the line, the next line is printed backwards. The Diablo even has optional proportional spacing, like the best typewriters, and can justify text so that it has even left and right-hand edges as you see here. Other options on the Diablo include the ability to plot graphs, as well as automatic insertion of paper.

The Qume Sprint 5 is another word processing quality printer based on a daisy wheel, while the NEC Spinwriter uses a glass reinforced plastic print thimble which is similar in concept to a 'golf ball'.

For these printers the potential purchaser is looking at an investment between $3500 and $5500, depending on the options chosen.

Summing up

At this stage it is wise to ask yourself what you will be doing with the computer, and choose your peripherals with this application in mind.

The choice of floppy disk is second to the choice of processor in determining the range of software available to the user. For this reason, unless you have a lot of money to spend on software I would recommend that 8080 and Z-80 users choose a disk that can run the CP/M operating system, since this guarantees a wide range of compatible software.

For business systems, the eight inch floppies offer a considerable performance over five inch types. In fact, when purchasing software it is advisable to note that the most prevalent distribution medium is not Kansas City cassette, but single-density eight inch floppy disk (apart from TRS-80 cassettes, that is!).

When considering printers bear in mind that, as with most mechanical equipment, spending more money on better equipment will return lower maintenance and running costs in the long run. For light work only, such as the occasional listing, an inexpensive printer could suffice. It all depends on your application. ●

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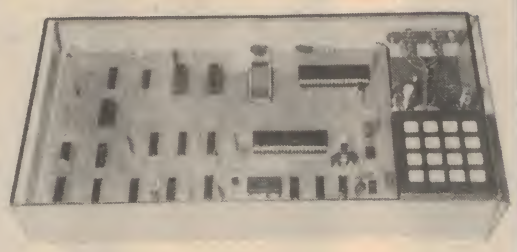

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Contains all components, a heavy gauge aluminium chassis (undrilled), and a Marviplate cover. Compact size 171 x 130 x 70 mm.

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Pet Food A large range of programs including games, business applications, and even a program to teach yourself Basic, are now available.

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Project 452

Guitar practice amplifier

Simple construction, low cost, good performance and superb neighbour relations are the features of this project!

David Tilbrook

THIS PROJECT has been designed to enable guitarists to put in long hours of practice and still keep that high power amp in the cupboard, where it belongs! It is a compact amp capable of about 7W into a 4 ohm load. This is enough power for practice purposes and just think of the greatly improved relations you will have with your neighbours.

We were in a considerable quandary as to how to present the project, whether it should be done as a complete practice unit with inbuilt speaker or simply as an amplifier to be connected to an external speaker. Finally we chose a compromise. The pc board has been designed in such a way that it can be used as a totally self-contained unit. The heatsinks for the output stage have been mounted on the pc board so that the only components separate to the board are the power transformer, 240 volt power switch controls, input and output jacks. We have shown the project mounted in its own box with power transformer but it should be a simple matter to construct the whole unit inside a small loudspeaker cabinet.

The unit has two inputs so that two guitars can be mixed together using the relative settings of the two input level controls. A pre-amp output enables your main high power amp to be driven from the guitar practice amp using the practice amp as foldback.

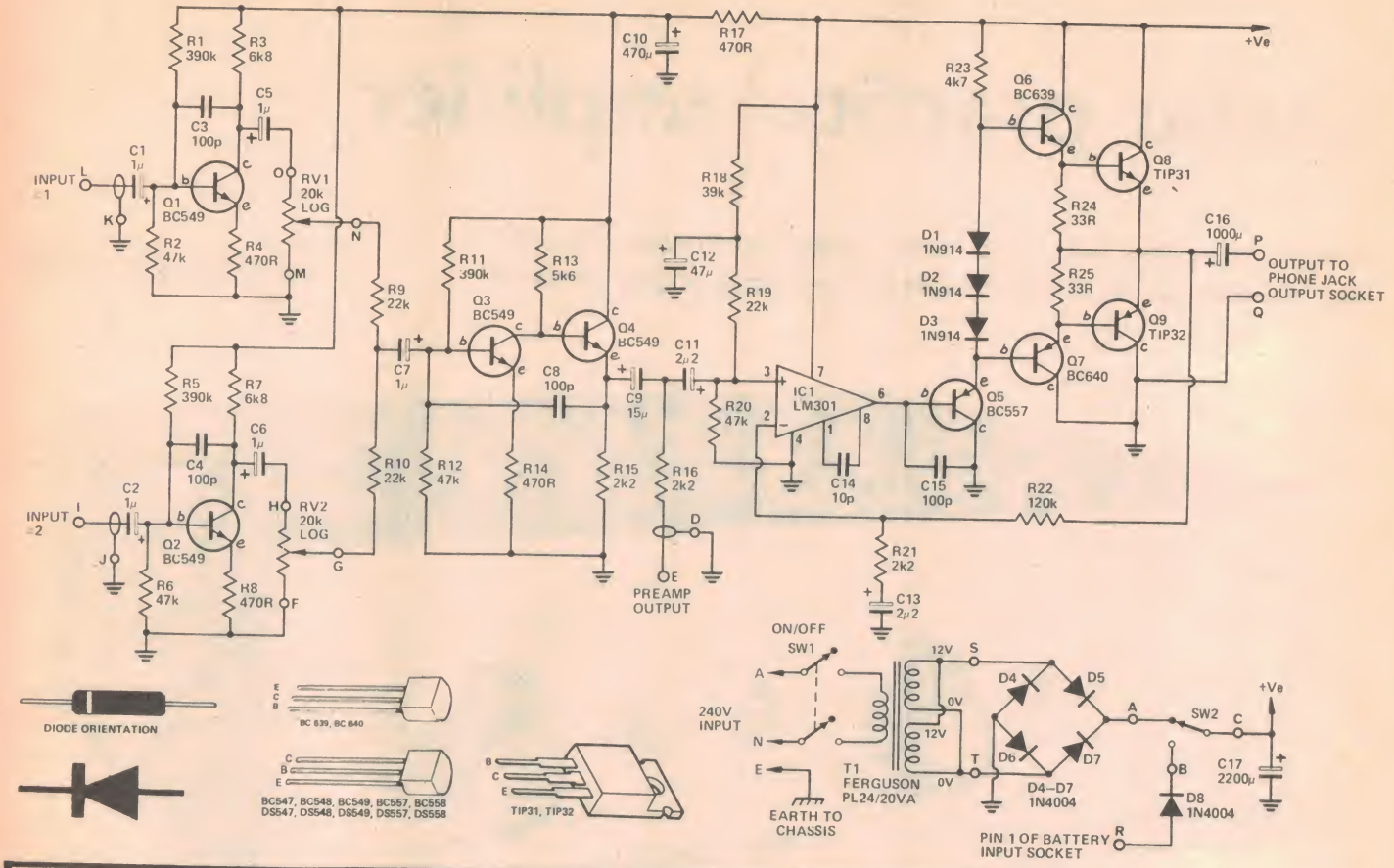
We provided the pc board with the necessary circuitry for a battery input but you might elect not to use this feature. If so diode D8 and the battery switch can be omitted with points 'A' and 'C' connected together by a wire link.

Construction

Construction of the project is reasonably simple since it is almost entirely devoted to construction of the pc board. Start as always by mounting the resistors and non-polarised capacitors. Mount the tantalum and electrolytic capacitors next, being careful to orient them correctly. These components could be irrepairably damaged if inserted the wrong way around. Mount the LM301 IC transistors and diodes, again being careful to insert these the correct way round. Finally the output devices can be mounted. Cut the centre (collector) lead off. This lead is connected to the case of the transistor internally, so in this case, electrical connection is made through the mounting screw that also serves to hold the heat sink in place. Place the heatsinks on the pc board and secure with the lower nut and bolt (not used to mount the transistors). Bend the leads of the output transistors and, using a small amount of thermal compound (non-toxic, such as Bevaloid GS13), mount the transistors with the leads protruding through the pcb.

Secure each transistor with a nut and bolt through both the transistor 'flag' and heatsink. Use a star washer between the head of the bolt and the copper pad on the pc board to ensure good electrical contact.

The prototype unit was constructed in a steel box measuring approx. 250 x 210 x 80 mm. Mount the pots and ▶



HOW IT WORKS

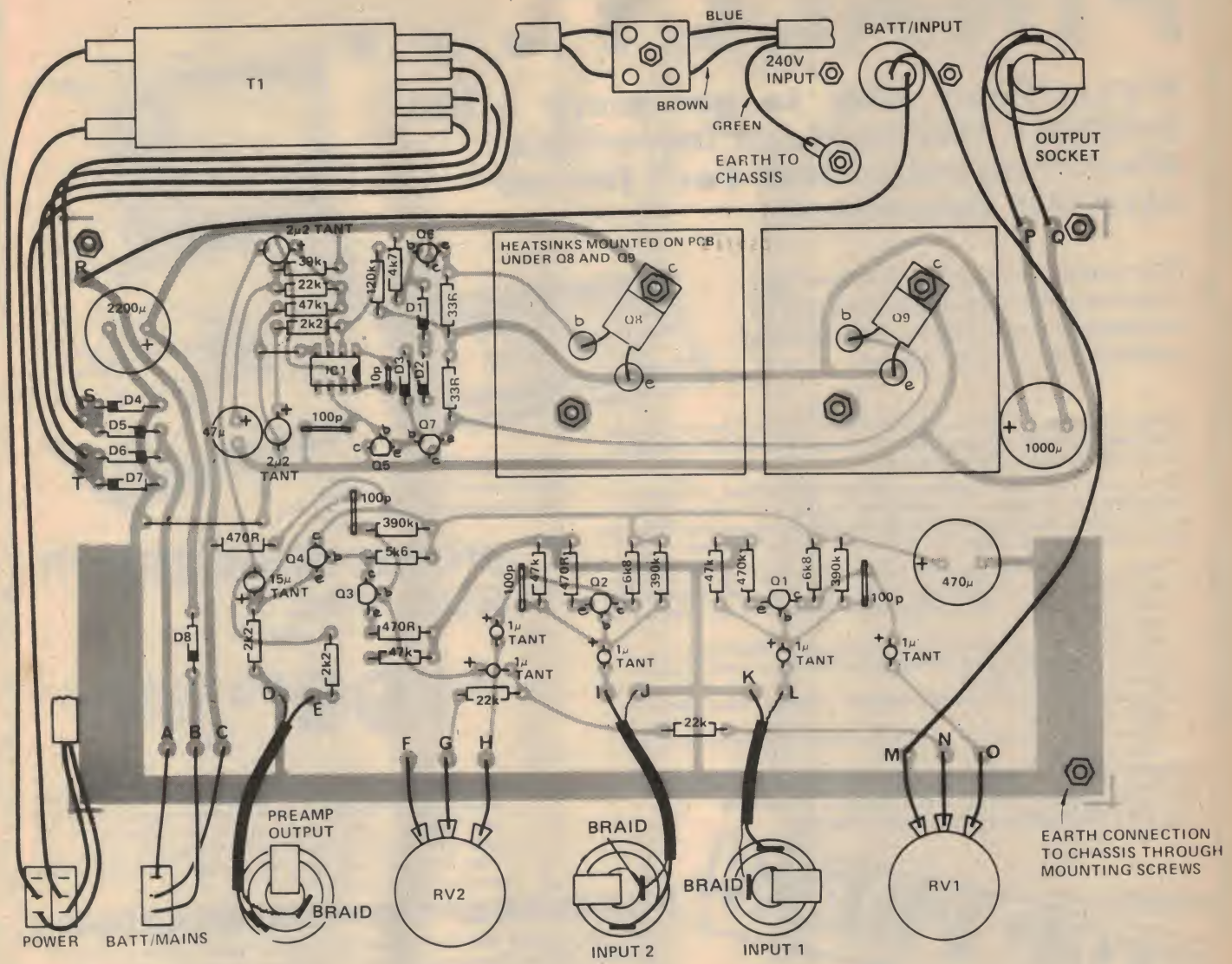
The two input stages formed around Q1 and Q2 are identical. Resistors R1, R2 and R4 form a very stable biasing configuration around Q1. The gain of this type of circuit is determined by the values of R3 and R4 (specifically, the gain is R3/R4). The load impedance on the output of the input stages is in parallel with R3, effectively decreasing the total value of impedance from collector to ground. Remember that, as far as signal is concerned, the positive supply rail is a short circuit to ground, since it is connected to ground through a 2200 uF capacitor. When all these factors are taken into account the gain of the first stage is about 10 since the impedance from collector to ground is about 4k7.

The signal which should be around 200 mV is then applied to the input of the second stage through potentiometers RV1 and RV2. The 22k resistors R9 and R10 prevent the output of one of the stages being shorted to ground when the other is turned right down.

The second stage works in exactly the same manner as the input stages; resistors R11, R12 and R14 forming the bias network for Q3. The voltage present on the collector of Q3 is around 9V which is approximately half the supply voltage. This is used to bias Q4 which is an emitter follower. This type of amplifier has no voltage gain but provides a low output impedance to drive the pre-amp output socket. Q3 has a gain of approx. 10. If the volume controls RV1 and RV2 are used in their middle positions the voltage out will be around one tenth of the voltage at their inputs since these are logarithmic pots. So, the signal voltages into Q3 should be in the order of 20 mV. This will be amplified to a level of 200 mV and applied to the input of the power amp. The power amp has been designed to deliver full power with an input voltage of 300 mV, so the amp should be easily driven to full output with usable settings

Since this is a guitar amplifier, it will spend most of its life hard into clipping. The output stage had to be robust! The basis of the output stage is the LM301 IC op-amp. This device gives all of the voltage gain in the power amp. The output of the IC is fed through a voltage follower Q5. This has no voltage gain and, like Q4, serves to decrease the impedance feeding the output stage. The three diodes, D1, D2 and D3, maintain 1.8 volts between the bases of Q6 and Q7. Each of these transistors will drop approximately 0.6 volts across their base-emitter junctions. This leaves a total of 0.6 volts to be dropped by the two 33R resistors, R24 and R25. Since these are of equal value they will each drop 0.3 volts and hold this voltage across the base-emitter junctions of the two output transistors Q8 and Q9. As these transistors require 0.6 volts to turn on they will remain off until the applied signal voltage causes the voltages on their bases to rise above 0.6 V. The extra 0.3 volts needed to turn on the output devices will be supplied by a mere 10 mA of current through the 33R resistors. Resistor R22 forms a feedback loop around the entire output stage to decrease distortion, stabilise the dc output voltage and set the overall gain of the power stage. (A process too difficult to go into here).

The op-amp will at all times attempt to make the dc voltage at the output equal to that voltage set up on its positive input. This voltage is determined by the potential divider formed by R18, R19 and R20. Since this is also the main input to the power amp any noise which might be on the positive supply rail (and supplies can get very noisy sometimes!) will be communicated directly to the input of the power amp, only to be amplified and applied to the loudspeaker. Capacitor C12 prevents this from happening by bypassing to ground any noise above a frequency of around 0.1 Hz.



PARTS LIST - ETI 452

Resistors all ½W, 5%

R1	390k
R2	47k
R3	6k8
R4	470R
R5	390k
R6	47k
R7	6k8
R8	470R
R9, R10	22k
R11	390k
R12	47k
R13	5k6
R14	470R
R15, R16	2k2
R17	470R
R18	39k
R19	22k
R20	47k
R21	2k2
R22	120k
R23	4k7
R24, R25	33R
RV1, RV2	20k log potentiometer

Capacitors

C1, C2	1µ 35V tantalum
C3, C4	100p disc ceramic
C5–C7	1µ 35V tantalum
C8	100p disc ceramic
C9	15µ 16V tantalum
C10	470µ 25V electrolytic
C11	2µ2 35V tantalum
C12	47µ 25V electrolytic
C13	2µ2 35V tantalum
C14	10p disc ceramic
C15	100p disc ceramic
C16	1000µ 25V electrolytic
C17	2200µ 25V electrolytic

Semiconductors

Q1–Q4	BC549, BC109, DS549
Q5	BC557, BC179, DS557
Q6	BC639
Q7	BC640
Q8	TIP31
Q9	TIP32
D1–D3	1N914
D4–D8	1N4004
IC1	LM301 op-amp

Miscellaneous

Box to suit, pc board - ETI 452, power transformer 12V @ 1.5 amps Ferguson PL24/20VA or similar, 2 x TO3 type heatsinks for pc board mounting, mains flex and plug, 2 pin DIN sockets (chassis mounting, speaker socket), DPDT 240V switch (power on/off), DPST switch (battery/mains switch), four phone jacks (mono), two knobs, grommets, nuts, bolts, pc board pins, four pc board mounting spacers.

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It is features like these which we believe make the Sorcerer Word Processor System OUTSTANDING value for money!

Note: Sorcerer, Video Monitor and printer as shown above are not included in the Rom Pac price!

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ONLY

$199.00 INCLUDING INSTRUCTION MANUAL!

Cat X-3085

SPECIAL NOTE: The incredibly low price of the Sorcerer Word Processor System is partly because a certain amount of 'do-it-yourself' work is involved for the operation of the system. If you do not have a basic electronics knowledge, make sure you can obtain some basic assistance before purchasing the system.

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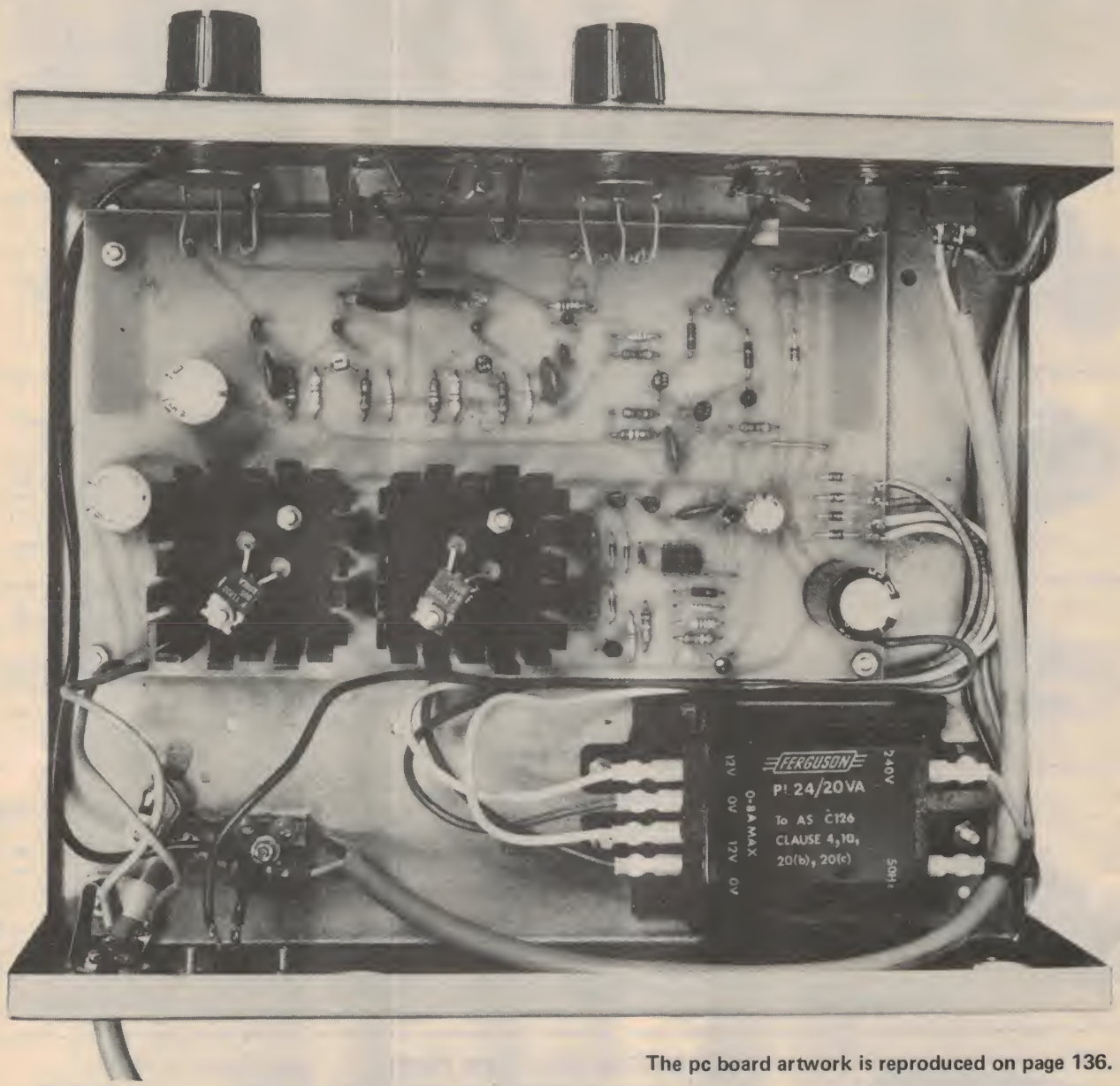


The pc board artwork is reproduced on page 136.

switches to the front panel, using the pot and switch nuts to secure the front escutcheon if you have one. Mount the output and battery input sockets on the rear panel. If you are using a battery input socket use something different to the output socket (which is usually a two pin DIN socket or a 6.5 mm jack socket) to avoid confusion.

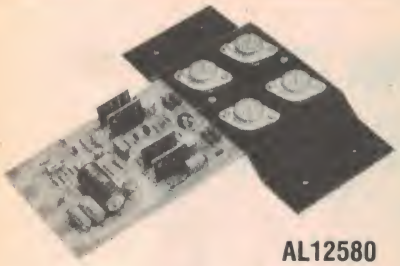
Mount the power transformer and make the 240 volt connections. The mains lead should be terminated immediately inside the case into a terminal block and the earth lead secured firmly to the chassis by a solder lug bolted to the case using a star washer. This lead must be the longest. A length of 240 volt cable should be used between the terminal block and the power switch. The Ferguson transformer specified comes supplied with cables to make its 240 connections. Solder these to the power switch as shown in the wiring diagram, then wrap the whole switch with insulation tape or enclose in large diameter heat shrink tubing so that no 240 volt connection is exposed.

Finally, the fully-loaded pc board can be secured into the case using short metal spacers. If pc board pins are used, all the connections to the board can be made after the board has been mounted. Connect the front panel controls, rear panel sockets and input sockets as shown in the wiring diagram. Use short lengths of shielded cable to make the connections to the two inputs and the pre-amp output.

Powering up

Make a final check of the wiring and pc board. If all is well, apply power. A slight turn-on thump should be heard at the moment of turn on. If the 'Input 1' volume control is now wound up some hiss should be heard from the loudspeaker. Do the same check on the other input. There is no set up procedure since the power amp stage is operating in class B and requires no bias adjustment. ●

RALMAR



AL12580

125 WATT POWER AMPLIFIER

This 125 watt module is at the top of the power range, and although it has been engineered to be one of the most rugged units available, it is still capable of providing high fidelity results with distortion levels down to 0.06 percent.

With a list of applications which include disco units, public address systems, electronic organs, and even domestic audio units. The AL12580 represents tremendous value for money, a fact which is confirmed by its large world wide sales.

Others available: AL5070 50 watt power amp; AL2550 25 watt power amp; AL1540 15 watt power amp.

SPECIFICATIONS

Max. Output Power 4Ω	.125 Watts RMS
Operating voltage	50-80 Max.
Loads	4-16 ohms
Frequency response	25Hz-20kHz (100 watts)
Sensitivity for 100 watts	450mV
Input impedance	33k ohms
Typical T.H.D 4 ohms load	0.1%
@ 50 Watts 8 ohms load	0.06%
S/N ratio	better than 80dBs
Semiconductor complement	13 transistors 5 diodes
Dimensions	205 x 190 x 36 mm

SPM90/45/65

STABILISED POWER SUPPLY

This module comprises a power supply stabiliser which is available in two voltages — 45 and 65 volts. The 45 volt unit is expressly designed to supply 2 x AL2550 modules, whilst the 65 volt version is capable of operating 2 x AL5070 or 1 x AL12580. The unit which is short circuit protected, provides a superior performance compared to the conventional unstabilised supply.

When ordering, the required voltage must be specified as follows: — SPM90/45 or SPM90/65.

SPECIFICATIONS	SPM90 45	SPM90 65
Output Voltage ± 5%	45 V	65 V
Max. O.P. Current	2.5 A	2.5 A
Output Impedance	— Less than 0.1 ohms —	
Noise & Ripple at 2A	— Less than 15 mV —	
A.C. Input Voltage	40-48 V	60-65 V
Dimensions	— 149 x 83 x 37 mm —	
Required Reservoir Capacitor (100 VW)	2200uF	3300uF

SPA25/SPA25H

STEREO PRE-AMPLIFIER

A top quality stereo pre-amplifier and tone control unit, the SPA25 provides a comprehensive solution for the front end requirements of stereo amplifiers or audio units. The six push button selector switch gives a choice of inputs together with two filters for high and low frequencies.

A modified version of the unit, suitable for driving the AL5070 and AL12580 is known as the SPA25H.

SPECIFICATIONS	
Frequency Response	20 Hz to 20 kHz ± 1 dB
T.H.D.	Less than .1% (Typically .07%)
Sensitivity Inputs	
1. Tape	100 mV/ .1MΩ } For an O/P of
2. Radio Tuner	100 mV/ .1 MΩ } 250 mV (500
3. Magnetic P.U.	3.5 mV/ 50 KΩ } mV SPA 25H)
Bass Control Range	± 15 dBs at 75 Hz
Treble Control Range	+ 10-20 dBs at 15 kHz
Signal/Noise Ratio	Better than 65 dBs (All inputs)
Supply	20 to 40 V (50 to 65 V SPA 25H)
Dimensions	300 x 90 x 33mm (Less controls)

MM100/MM100G

MICROPHONE & GUITAR MIXER

The module MM100 is a single channel pre-amplifier providing facilities for mixing 3 input channels suitable for driving power amplifiers such as the AL5070 and AL12580. The unit which features a master volume control and full range treble and bass controls is available in two versions: —

1) designated MM100, this version provides suitable inputs for magnetic cartridge, microphone and a tape input (which may be modified to a second pick-up input by the cutting of a link).

2) in the second version known as MM100/G, the unit has input facilities for two guitars and a microphone.

SPECIFICATIONS	MM100	MM100G
Frequency Response	±1db	±2dbs
Magnetic P.U. I/P 1 (R.I.A.A. equalisation within ± 1db)	20Hz - 20KHz	
Microphone I/P 2	25Hz - 10KHz	25Hz - 10KHz
Tape I/P 3	25Hz - 20KHz	
Guitar I/P 1 and 3		25Hz - 15KHz
Sensitivity For 500mV O/P		
Pick Up	3.5mV	
Microphone	1.5mV	1.5mV
Tape	50mV	
Guitar		50mV
Input Impedance all I/P's	50K ohms	50K ohms
Tone Control Range		
Treble	±12db@10KHz	±10db@4KHz
Bass	±12db@80 Hz	+5db –10db @ 80 Hz
Operating Voltage Range	40v - 65v	40v - 65v
Supply Current	6mA - 10mA	6mA - 10mA

Overload – All I/P's:- 20 - 36dbs dependant upon settings of master and channel gain controls.

S453

PUSH BUTTON STEREO FM TUNER

The S453 module comprises a push button vari-cap tuned module incorporating a phase locked loop decoder for the reception of mono and stereo broadcasts. The unit is fitted with a 4 position switch which provides for the selection of 4 pre-tuned frequencies. Careful circuit design has resulted in a non critical unit that may be installed into a wide range of equipment without difficulty.

SPECIFICATIONS

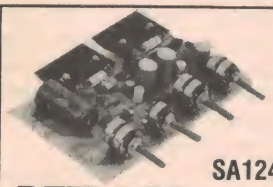
Tuning range		88–108 mHz
Sensitivity		4μV for 30dB S/N
Audio output		200mV for ±75kHz deviation
Stereo separation		30dB
Operating supply voltage		18–25V
Supply current		43mA for Vs = 22V
Dimensions . . .	Tuner P.C.B.	125mm x 80mm
	Pre-set P.C.B.	45mm x 80mm

MPA30

MAGNETIC CARTRIDGE PRE-AMP

SPECIFICATIONS

Sensitivity	3.5 mV for 100 mV output
Equalisation	Within ± 1 dB from 20 Hz to 20kHz
Input Impedance	50 K ohms
Supply	20 to 30 V
Dimensions	110 x 50 x 25mm (Inc. DIN socket)



SA1240

12 + 12 STEREO CHASSIS

SPECIFICATIONS (Each channel)

Output Power	12 watts RMS
Load Impedance	8 ohms
T.H.D.	Less than .5% (Typically .3%)
Frequency Response	50 Hz to 20 kHz ± 3 dBs
Tone Control Range	± 12 dBs at 100 Hz and 10 kHz
Sensitivity	170 mV for full output
Input Impedance	1 M ohms
A.C. Requirements	27 V.A.C. rated at 1.5 A
Dimensions	200 x 130 x 33mm (Less controls

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Project 321

Fuel level monitor sounds alarm when your fuel runs low

Have you ever been caught with your fuel level down (to zero)? Despite the inclusion of fuel gauges in dash panels, many motorists still get caught. It's understandable under circumstances where great concentration is required and the fuel gauge is forgotten. Don't you get caught — build our low-fuel warning project.

THIS PROJECT is a medically non-approved ulcer generator. It's designed to make you *worry* for twenty minutes or so before you are finally stranded through lack of fuel!

This alarm is designed for use in modern vehicles fitted with 12 V electrical systems only. It is driven from the vehicle's existing fuel gauge system and operates a LED and an alarm (optional) when the fuel level falls below a pre-set value.

Design

The fuel metering system in a modern car consists of a rheostat 'transmitter' in the fuel tank with its wiper mechanically linked to a float, an instrument regulator, and the fuel gauge. The current through the gauge is controlled by the float and the voltage supply is regulated to ensure reliability of calibration and to avoid the meter varying with battery voltage. The regulator output to the instrument is usually five or ten volts.

The fuel gauge is a bi-metallic type of meter with a coil of resistance wire wound around a strip of two dissimilar metals. When the current is passed through the coil it heats up and heats the bi-metal strip which bends, moving the pointer. Though well-damped and rugged, they are massively inaccurate. When the ignition is switched off the gauge is returned to empty by a return magnet inside the gauge, otherwise it would show a reading when the ignition was turned off. The voltage across the rheostat increases as the level in the tank drops, developing typically three to four volts when the tank is empty.

This project monitors the voltages across the rheostat (wire C) and compares it to a reference voltage taken from the instrument regulator (wire B). The trigger point can be adjusted so the alarm will switch at any level on the fuel gauge by adjusting the pc-mounted trim pot, RV1.

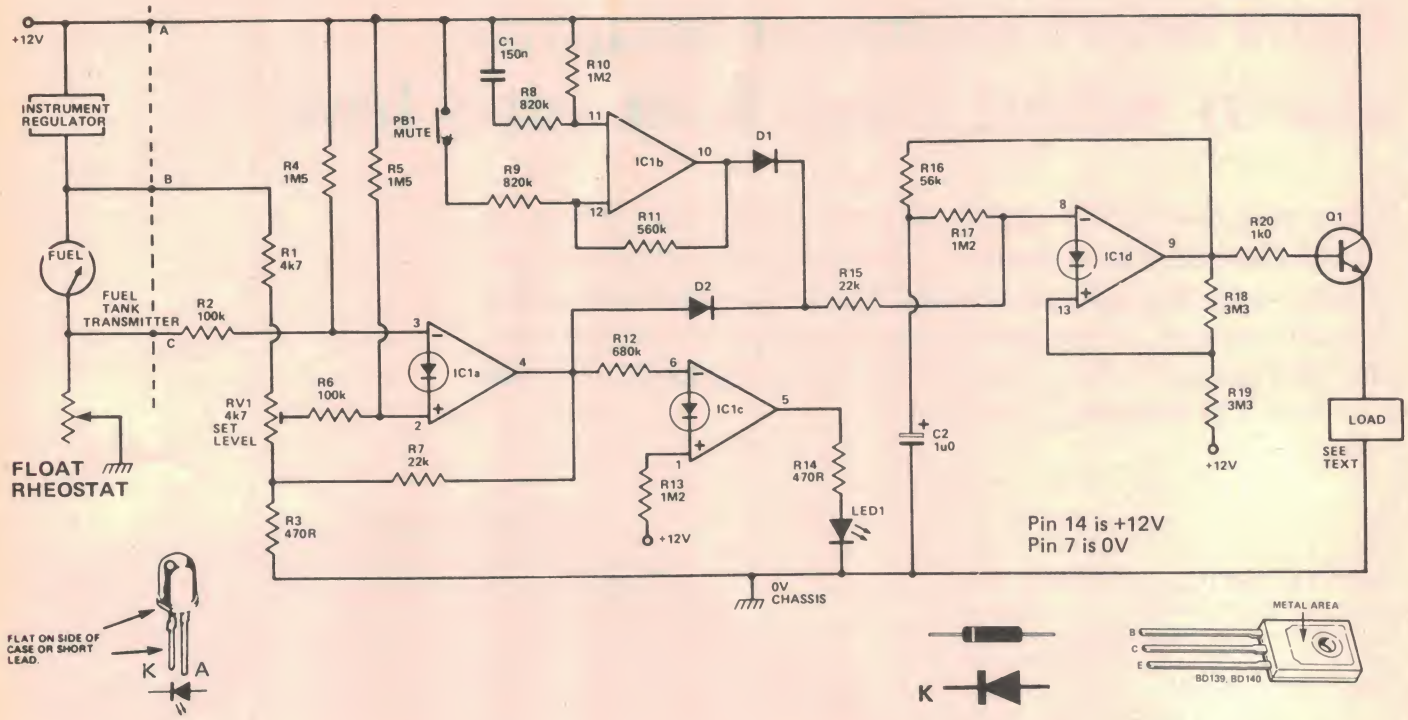
When the fuel level drops below the pre-set point the alarm sounds and the LED lights. The alarm output is a low frequency oscillating voltage which can be used to drive any 12 V alarm device greater than 100 ohms impedance. We used a Sonalert piezo-electric alarm, which is very loud and should be heard readily over quite high noise levels that may occur inside a vehicle.

A mute circuit is included to stop the noise at the push of a button. However, the LED remains lit as a reminder. When the ignition is switched off the mute is re-set, and the alarm is activated immediately the ignition is turned on if the fuel level is still low.

Construction and installation

Construction is quite simple as all the components are mounted on the pc board, except the LED, push button and alarm. Be careful to orient the diodes and the tantalum capacitor the right way round. The unit can either be mounted under the dash with the LED, push button and alarm mounted on a bracket, or the complete unit built into a small box. We used a good looking slim box by PacTex, distributed by Associated Controls (see Shoparound) with the LED, pushbutton and alarm mounted on the front panel. The connections to the car's wiring are taken from a plastic terminal strip mounted on the rear of the box.

Connection into the car's wiring system may be a lot more difficult. Make sure that you know what you're getting yourself into before you think about building the unit! The dash in ▶

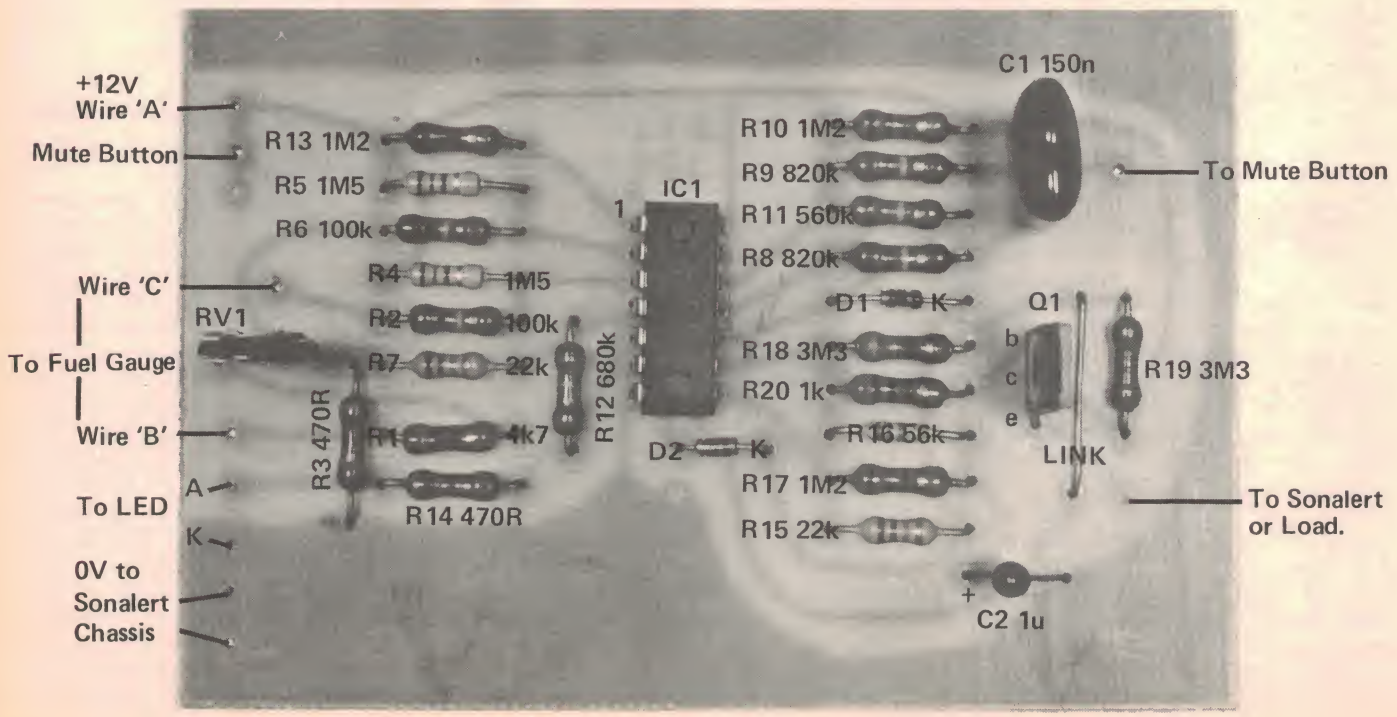


most cars will have to be removed and the wires to the fuel gauge identified and tapped. This can take the best part of a day, so give yourself plenty of time. Some cars use a printed circuit dash instead of a wiring loom and the connections can be soldered onto the back of the pc board, taking care not to damage it.

The other two wires, 12 volts and earth, can be taken to any convenient point in the car's wiring, however the 12 volts must be switched via the ignition switch.

After the unit has been assembled and installed the fuel alarm level must be set. Run the fuel in the tank down to the desired level and adjust the trimpot until the alarm just sounds. The adjustment should allow you to do this at any fuel level for a check of correct operation after the unit is installed.

When the fuel gets near the pre-set level the alarm will 'blip' as the fuel sloshes around in the tank, making quite a fuss if you let the fuel drop below the set level. ●



PARTS LIST - ETI 321

Resistors all ¼W, 5%

R1	4k7
R2	100k
R3	470R
R4, R5	1M5
R6	100k
R7	22k
R8, R9	820k
R10	1M2
R11	560k
R12	680k
R13	1M2
R14	470R
R15	22k
R16	56k
R17	1M2
R18, R19	3M3
R20	1k
RV1	5k or 4k7 min vert mounting trimpot

Capacitors

C1	150n greencap
C2	1μ tantalum

Semiconductors

D1, D2	IN914 or similar
LED1	TIL 220R Red Led or similar
Q1	BC139, BC184 or similar
IC1	LM3900

Miscellaneous

ETI 321 pc board, Sonalert or similar warning device, box to suit (see text), pushbutton (push to make), terminal strip.

BELOW LEFT is the pc board overlay. Take care with the orientation of the diodes and tantalum capacitor (C2). Initially, we cut the board for behind-dash mounting and had to secure it in the PacTec case with a strip of double-sided tape. The pc board artwork is below.

HOW IT WORKS – ETI 321

The circuit consists of a voltage comparator, IC1a, an LED driver, IC1c, an astable multivibrator used as a low frequency oscillator, IC1d, and a mute circuit, IC1b.

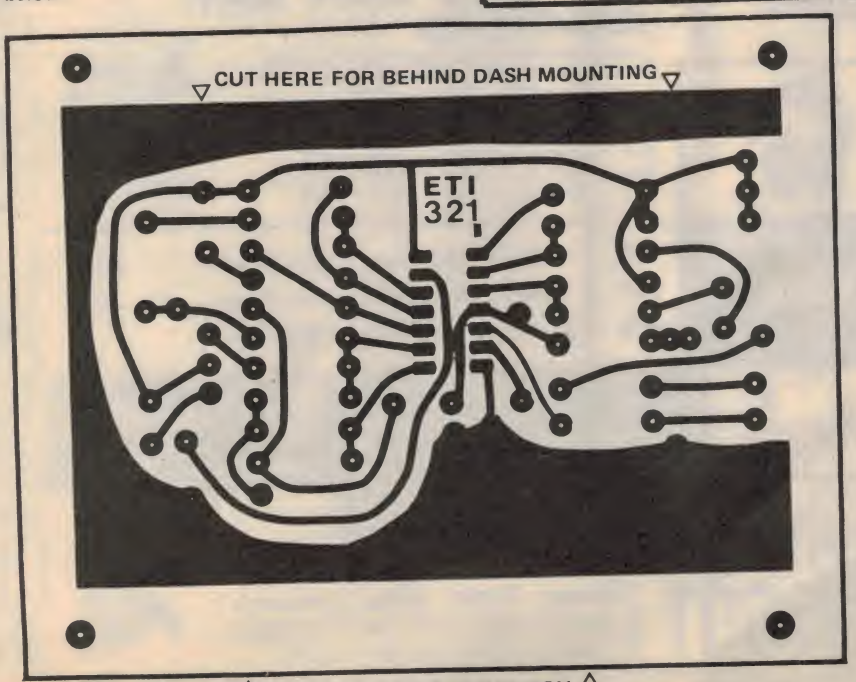
IC1a is wired as a voltage comparator with a small amount of hysteresis provided by R7 and R3. When the fuel level in the tank drops, the voltage across the rehostat rises. This voltage is fed to the inverting input of IC1a and is compared to the preset voltage level from RV1 on the non-inverting input. When the voltage across the rheostat is low, the output of IC1a is high. When the tank empties to the point where the voltage on the inverting input is just higher than the reference, the output of IC1a goes low.

The output of IC1a is connected to the inverting input of IC1c. When the output of IC1a goes low, the output of IC1c goes high, lighting the LED.

The low from IC1a is also fed to the negative input of IC1d, through D2 and R15, enabling the oscillator. The output of the oscillator is fed to an emitter follower, Q1, which drives the alarm.

When the ignition is first turned on the mute circuit, IC1b, is automatically set to have a low on its output (pin 10) by C1 charging via R8. D1 is reverse biased and the circuit is isolated from the oscillator. When the mute button is pressed the output is latched high, D1 is forward biased and the inverting input of IC1d is held high disabling the oscillator. Diode D2 is reverse biased when this occurs and the output of IC1a remains low. The LED will still be lit.

When the power is turned off and re-applied the mute circuit is reset to a low output and the circuit is ready to be retriggered.



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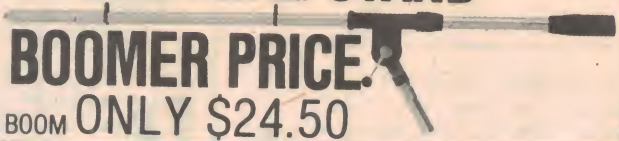

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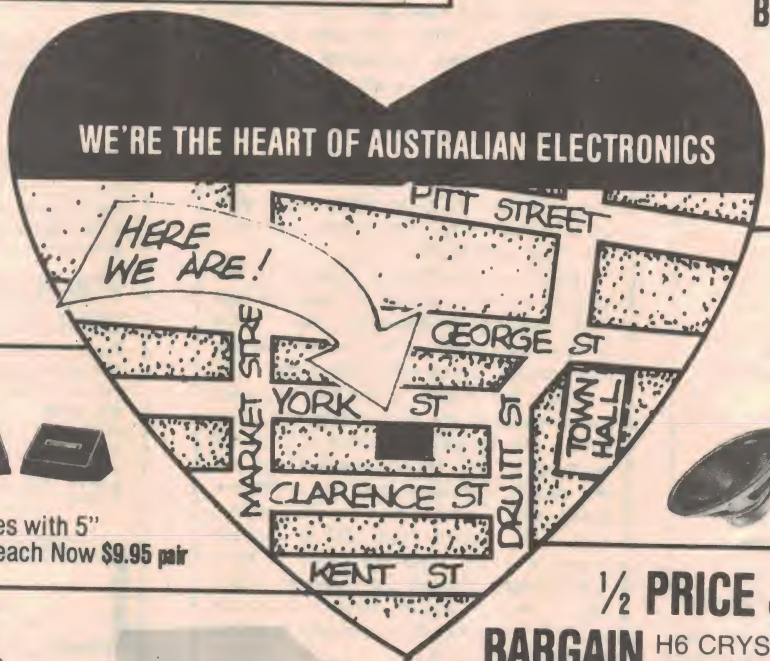

NEW YEAR SPECIAL

DCI CAR SPEAKERS
4 or 8 ohm speaker boxes with 5" speaker. Usually $9.95 each Now **$9.95 pair**

SPEAKS A LITTLE CLEARER

Davred Speakers
Model EP F46 6" x 4" 5 watt
Was $6.95 Now **$3.45**
Model MF80T 8" 15 watt, wide range in 3 ohm
Was $11.50 Now **$5.25**

NEW PRODUCT

INSTRUMENT CASE IC3
5½ x 4½ x 2¼ with swivel mounting bracket. Has a million and one uses. **LOOK AT THE PRICE ONLY**
$10.95

½ PRICE JANUARY BARGAIN

H6 CRYSTAL EARPIECE
Was **$2.40** Now **$1.20 each**

LOOK LOOK LOOK

DAVRED METAL BOXES

These are the little two-tone brown boxes that are being used for all types of kits and projects. Number 4 has rubber feet

	Length	Width	Depth	
No. 1	82mm	70mm	50mm	$2.95
No. 2	100mm	82mm	54mm	$3.45
No. 3	12mm	89mm	54mm	$3.95
No. 4	140mm	120mm	90mm	$4.75
No. 5	125mm	163mm	120mm	$6.25

IN STOCK NOW

A fabulous range of stereo heaphones from **$9.95** — come to the heart of electronics and browse.

SEE US FIRST FOR MINIATURE TRIMMERS — Ex Stock

¾" Rectangular Trimmer sealed for hot water immersion. 10ohm-1 Meg **$2.20 ea.**
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PT5	PC board pot 500 ohm - 2 meg **35¢ ea.**
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PT9	PC board pot 100 ohm - 1 meg **25¢ ea.**

JANUARY SPECIAL

Be quick, the ever popular PL259 plug normally **$1.20**
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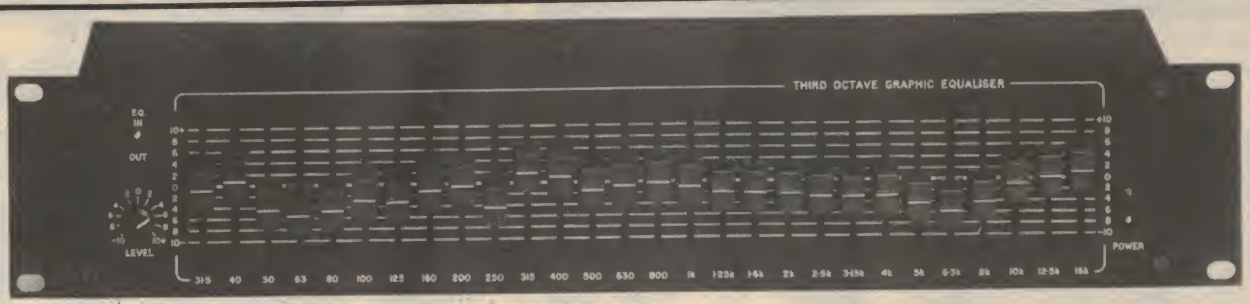
⅓ OCTAVE GRAPHIC EQUALISER

MODEL 2801



Specifications:

DISTORTION (@ 2 volts out)	Less than .05% 20Hz–20kHz
FREQUENCY RESPONSE	
– EQ. OUT	Flat
– EQ. IN	20Hz – 20kHz ± ½ dB
SIGNAL TO NOISE RATIO (@ 2 volts out, controls flat)	greater than 82dB
OUTPUT IMPEDANCE:	100 Ohms (will drive low or high impedance equipment)
INPUT IMPEDANCE:	50K to 100K depending on input configuration.
MAXIMUM INPUT VOLTAGE:	10 volts
EQ, centre frequencies:	31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1K, 1.25K, 1.6K, 2K, 2.5K, 3.15K, 4K, 5K, 6.3K, 8K, 10K, 12.5K, 16K, Hz
Range of Controls:	
Individual Filters:	±10dB
Level	±15dB
CONTROLS	
EQUALISATION:	28 Vertical potentiometers continuously variable ±10dB
LEVEL:	Rotary potentiometer variable ±15dB
EQ BYPASS:	Toggle Switch
POWER:	" "
Terminations:	Rear panel cannon sockets & P.M.G. sockets for input and output.
PHYSICAL	
Size	19" x 3½" x 4" (Standard rack mount size)
Weight	4 kg
Finish	Front & rear panel brushed & anodised black with white lettering, black Marviplate cover

The 2801 is a single channel graphic equaliser that divides the audio spectrum into twenty-eight one third octave bands. Each frequency segment is controlled by a slider that provides up to ±10dB of adjustment in standard ISO steps.

The 2810 was designed primarily to compensate for any deficiencies in the linearity of speaker systems, acoustic peculiarities of the hall or listening room, and inadequacies of program source quality.

In P.A. application the equaliser may be used to improve sound quality and increase intelligibility by attentuating problem frequencies that cause ringing, boominess or other disruptive resonances that occur in acoustically difficult rooms. The 2801 allows sound systems to be "tuned" according to the special acoustics of a room, to maximize output and minimize feedback.

As a creative tool in sound recording or re-recording the 2801 allows complete freedom in contouring response over the complete audio spectrum from 31.5Hz to 16KHz.

- 28 adjustable controls on 1/3 octave ISO centre frequencies
- Vertical slide controls give a graphic representation of the resulting response curve.
- 10dB boost or 10dB cut at any centre frequency.
- Gain control giving ±15 dB operating range.
- Balanced or unbalanced input.
- Equaliser bypass switch.
- Standard rack mounting – only 3½" high.

Available as a complete kit for $198.00.

Post and pack $3.00

Construction notes $1.00, refundable on kit price.

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BD139 10 up	4.50
BD140 10 up	4.50
SC141D 10 up	1.10
SC151D 10 up	2.10
RED LEDS 10 up	1.40
RED LEDS 100 up	11.00
YELLOW LEDS 10 up	2.90
8 PIN I/C SKTS 10 up	2.00
BC547 10 up	1.00
BC548	0.15 ea.
BC549	0.19 ea.
MJ802	3.60
6,800/50V CAPS (LUG)	4.50
5,600/40V CAPS (PCB)	1.90

10 TURN POTS

¼" SHAFT. VALUES: 100, 500, 1K, 2K, 5K, 10K, 20K, 50K, 1M.

Inc. tax **$6.25** ea.

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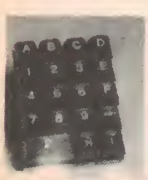
All prices include sales tax. Post and pack min. $1.00. Extra post and pack for heavier items or where indicated. Extra heavy items sent COMET 'freight on': Offers current for six weeks. Prices subject to change without notice.

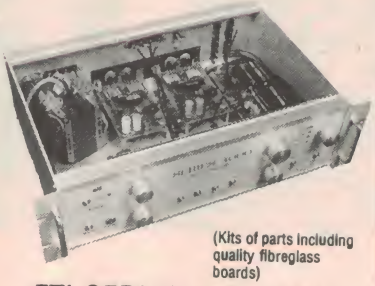
We also stock multimeters, solder, computer products (incl. central data), specialised kits, Veroboard, soldering irons, solderwick, antennas, hi-fi turntables, etc.



HEX KEY PAD

$17.90

KITS & CIRCUIT BOARDS



(Kits of parts including quality fibreglass boards)

ETI SERIES 4000 AMP

- **Complete Kit $175.00**
- Quality front panel to suit above ... $7.99
- ETI 470 kit of parts 19.90
- ETI 480 kit of parts 100w (incl. bracket) 19.75
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- Transformer to suit 22.90
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- All parts available for DREAM computer project.
- P.C.B.'S (all quality fibreglass boards)
  - ETI 574 disco strobe 2.80
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Project Boards (Fibreglass)

ETI 043	1.40	ETI 137B	2.90	ETI 547	2.20
ETI 044	1.30	ETI 139	1.90	ETI 581	2.20
ETI 047	1.50	ETI 245	1.60	ETI 583	2.20
ETI 061	1.40	ETI 417	1.80	ETI 585R	1.60
ETI 062	1.80	ETI 445	1.50	ETI 585T	1.40
ETI 063	1.70	ETI 446	1.90	ETI 586	2.30
ETI 064	1.70	ETI 449	1.50	ETI 603	2.50
ETI 065	1.70	ETI 450A	1.90	ETI 604	1.60
ETI 067	1.80	ETI 450B	1.90	ETI 635	2.90
ETI 068	1.40	ETI 480	2.40	ETI 638A	3.90
ETI 071	1.40	ETI 480PS	2.40	ETI 708	1.90
ETI 072	1.80	ETI 481M	2.00	ETI 713	3.90
ETI 081	1.50	ETI 481PS	3.50	ETI 714	1.90
ETI 083	1.80	ETI 483	2.20	ETI 717	2.90
ETI 084	1.70	ETI 484	3.90	EA 78A06	2.90
ETI 085	1.30	ETI 485	2.90	EA 78TM8	2.00
ETI 130	1.90	ETI 486	2.90	EA 78N6	3.20
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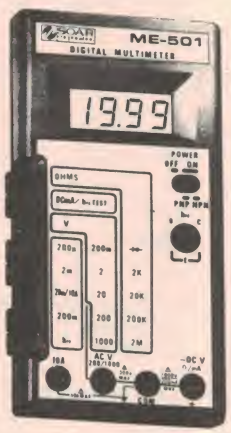

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Electronic ohmmeter features linear scale and high accuracy

Many workshop, laboratory and hobby applications require accurate measurement of resistor values or accurate matching of resistors of the same nominal value. This simple instrument fills the bill for the sort of measurement required.

THIS INSTRUMENT is a simple and inexpensive semi-precision ohmmeter that can be used to give accurate readings of resistance from a few tens of ohms to one megohm. The unit has four decade ranges covering 1k to 1M full scale and has a full scale accuracy of 2% if low tolerance range resistors are used.

Conventional moving coil ohmmeters have non-linear scales which typically cover two to four decade ranges of resistance value on a single scale. With such a range of resistance it is impossible to obtain an accurate reading, especially at the higher values. To measure resistance values with reasonable accuracy, the usual method is to use a Wheatstone Bridge, often very expensive and time consuming.

By contrast, this ohmmeter gives resistance readings on a linearly calibrated scale and covers only a single decade of resistance on each switched range. The instrument thus gives inherently more accurate readings of resistance than multimeter type ohmmeters.

The technique

The circuit consists of a voltage reference feeding an operational amplifier. The gain of the op-amp is set by the ratio of the range resistors, R3 to R6, to the feedback resistor, Rx. A moving-coil meter is connected to the output of the op-amp and the reading will be the reference voltage multiplied by the gain of the op-amp. Therefore, the reading is proportional to the gain of the op-amp which in turn is proportional to the value of Rx, the unknown resistor.

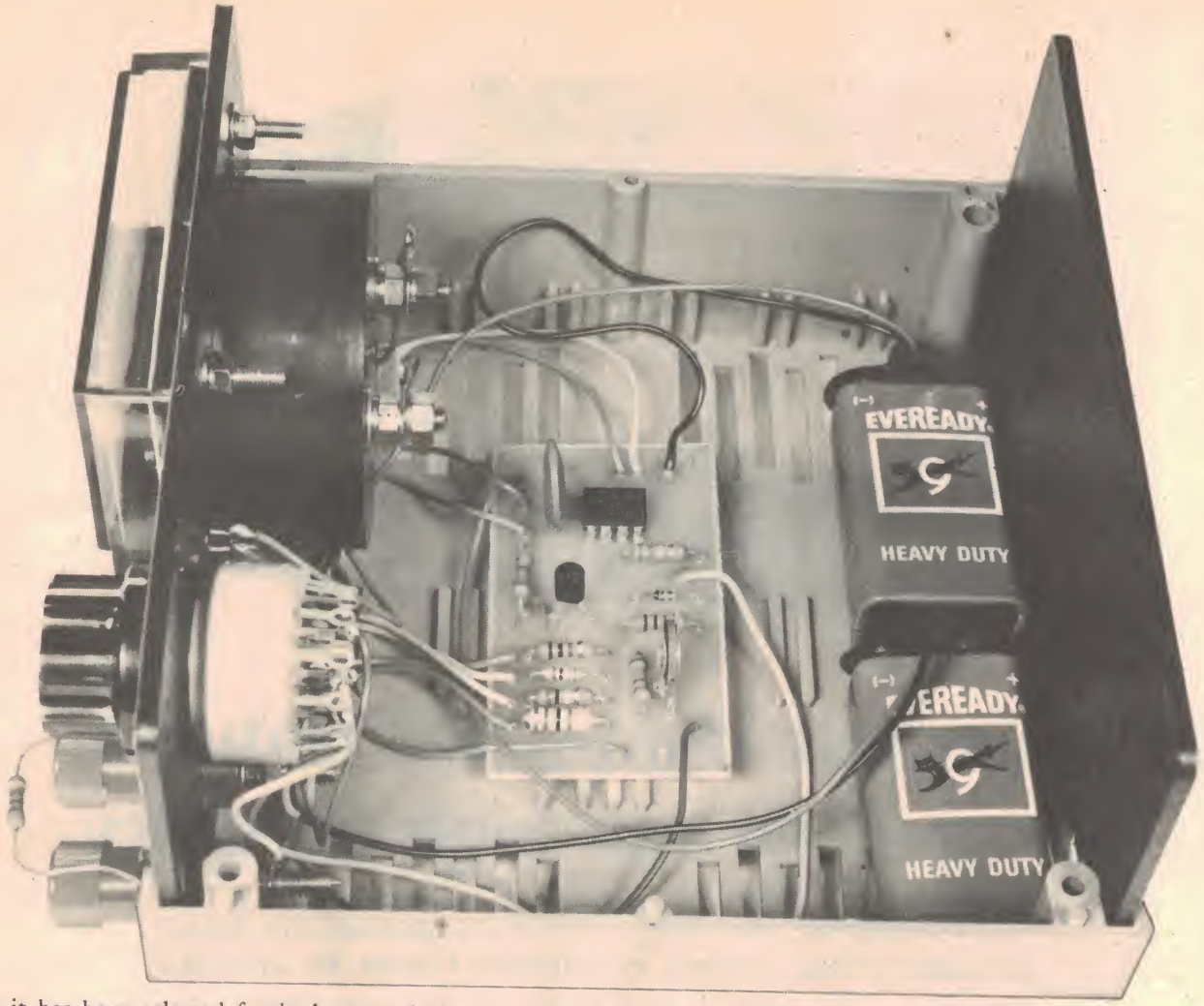
The op-amp we selected is a 301, used for its low input current. This ensures that the highest resistance range is not shunted by the input resistance of the op-amp causing inaccuracy at higher values. In fact a 10M range could be added but would not be accurate over about a few megs. The lowest resistance range is determined by the current capacity of the op-amp, reference supply, and the batteries.

Calibration of the instrument is achieved by adjusting the trimpot for correct reading with a known resistance.

Construction

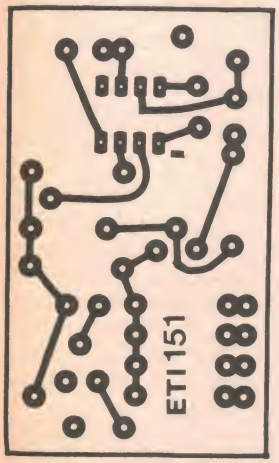
The ohmmeter can either be constructed as a completely contained unit, with its own moving-coil meter, as we have done, or it can be built as an add-on to an existing multimeter having a 1mA dc current range. As the meter is the most expensive part the latter method is by far the cheapest way of doing it.

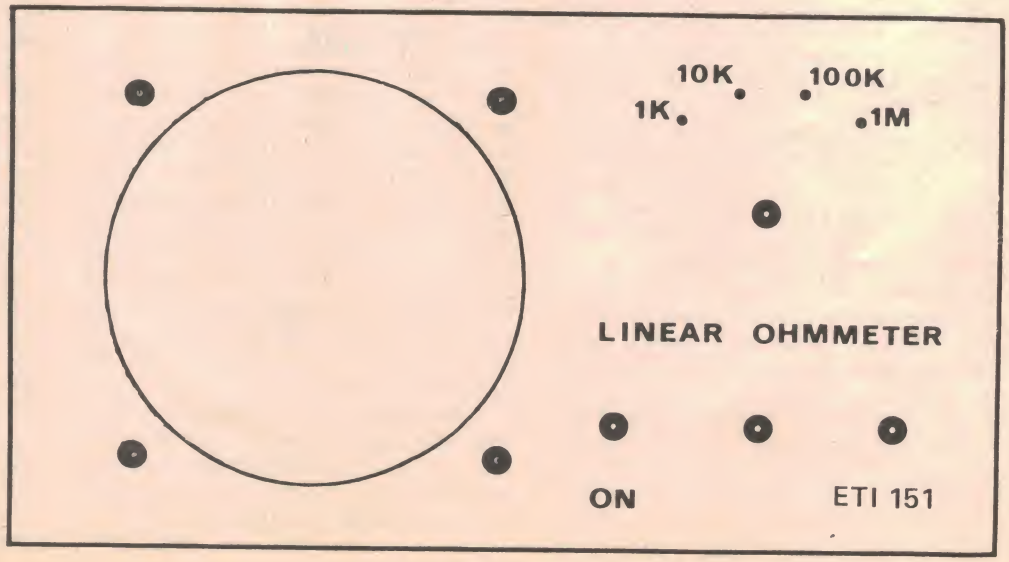
The construction is straightforward with all the minor components mounted on a pc board. Take care with the polarity of the zener diode. The 301 op-amp cannot be substituted by a ▶



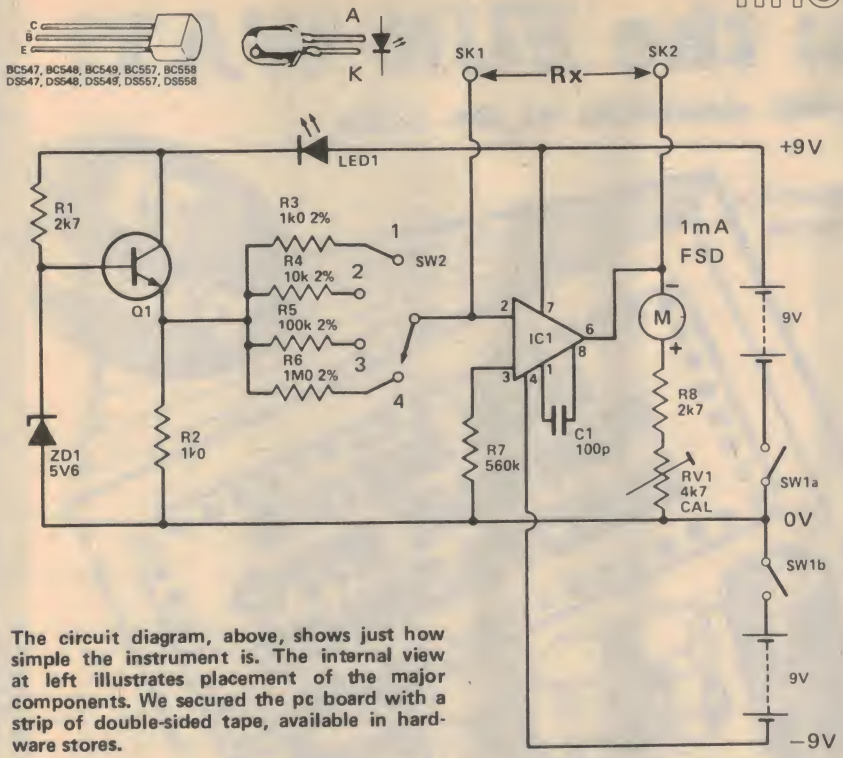
741 as it has been selected for its low input current. The overall accuracy of the instrument is determined by the tolerance of the range resistors (R3 to R6) and the accuracy of the meter. If 1% or 2% resistors are used the accuracy of the instrument will be about two percent. See Shoparound for a list of suppliers with close tolerance resistors.

When the pc board assembly is complete, fit the board into the box and complete the wiring to the major components. We used a common plastic case, identical to the one used for the Linear Scale Frequency Meter in the December issue. If you are making an add-on version of the meter, fit a couple of screw terminals in place of the meter





RIGHT: Front panel artwork. Scotchcal overlays will be available from Radio Despatch Service in Sydney.



The circuit diagram, above, shows just how simple the instrument is. The internal view at left illustrates placement of the major components. We secured the pc board with a strip of double-sided tape, available in hardware stores.

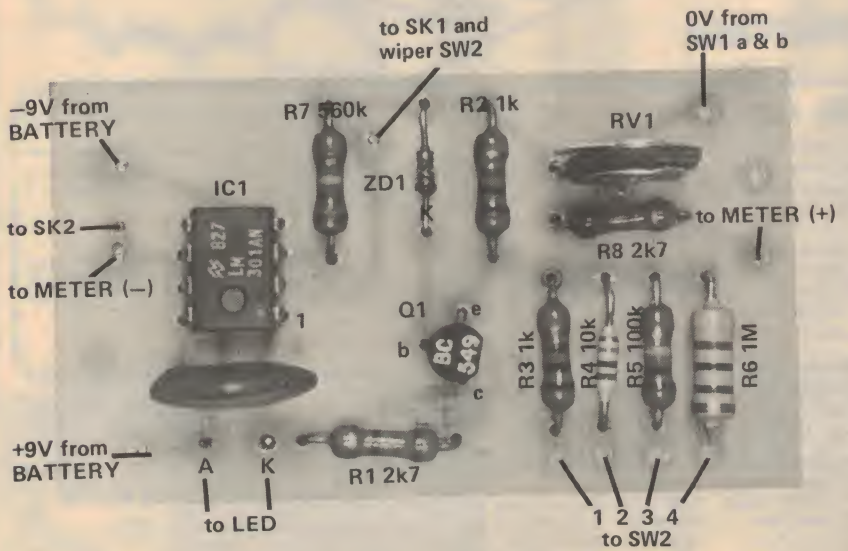
for connection to your multimeter.

We used a 'Lorlin' range switch made by C&K. These switches start out life as a two-pole six-position switch and are easily changed to four position by moving round a small metal ring beneath the securing nut. Only one pole is used. In this way, C&K have come up with a single switch which can be changed to suit your own needs.

If your supplier stocks this switch he will show you how to adjust it. Any other single-pole four-position switch will do just as well.

Calibration

When construction is complete, switch the unit on and check that the LED lights up. If it doesn't, check the wiring and the polarity of the LED. When all is well connect an accurately known resistor (having a value within the range of the instrument) across the terminals and adjust the trimpot for the correct reading. The unit is then ready for use and should not require further calibration. You could purchase a 1k, 1% resistor specifically for this purpose. ●



HOW IT WORKS – ETI 151

The linear scale ohmmeter circuit is divided into two parts: a reference voltage generator and a readout unit that indicates the value of the resistor under test. The reference voltage generator section of the circuit comprises zener diode ZD1, transistor Q1, and resistors R1 and R2. The action of these components is such that a stable reference of about 5V is developed across R2. This reference voltage is fed to the op-amp resistance-indicating circuit via range resistors R3 to R6.

The op-amp is wired as an inverting dc amplifier, with the 1 mA meter and R8-RV1 forming a voltmeter across its output, and with the op-amp gain determined by the relative values of ranging resistors R3 to R6 and by the negative feedback resistor Rx. RV1 is adjusted so that the meter reads full scale when Rx has the same value as the selected range resistor. Under this condition the op-amp circuit has a voltage gain of precisely unity. Since the values of the reference voltage and the ranging resistors are fixed, the reading of the meter is directly proportional to the value of Rx, and the circuit thus functions as a linear-scale ohmmeter and has a full scale value equal to the value of the selected range resistor.

PARTS LIST - ETI 151

Resistors all ½W
(* See text)
R1 . . . . . 2k7 5%
R2 . . . . . 1k 5%
R3 . . . . . 1k*
R4 . . . . . 10k*
R5 . . . . . 100k*
R6 . . . . . 1M*
R7 . . . . . 560k 5%

RV1 . . . . . 5k minimum vertical trim pot

Capacitors
C1. . . . . 100p ceramic

Semiconductors
LED1. . . . . TIL220 red LED or similar
ZD1. . . . . 5V1 400mW zener diode
Q1 . . . . . BC109, BC549, or similar
IC1 . . . . . 301 op amp

Miscellaneous
SW1. . . . . DPDT minimum toggle switch
SW2. . . . . one pole four position wafer switch

M1 . . . . . 1mA FSD meter 60 mm square, University TD66 or similar

SK1, SK2 . . . screw terminals

ETI 151 pc board, two 9V batteries (type 216) and battery clips, plastic case 130 mm x 130 mm x 75 mm, knob.

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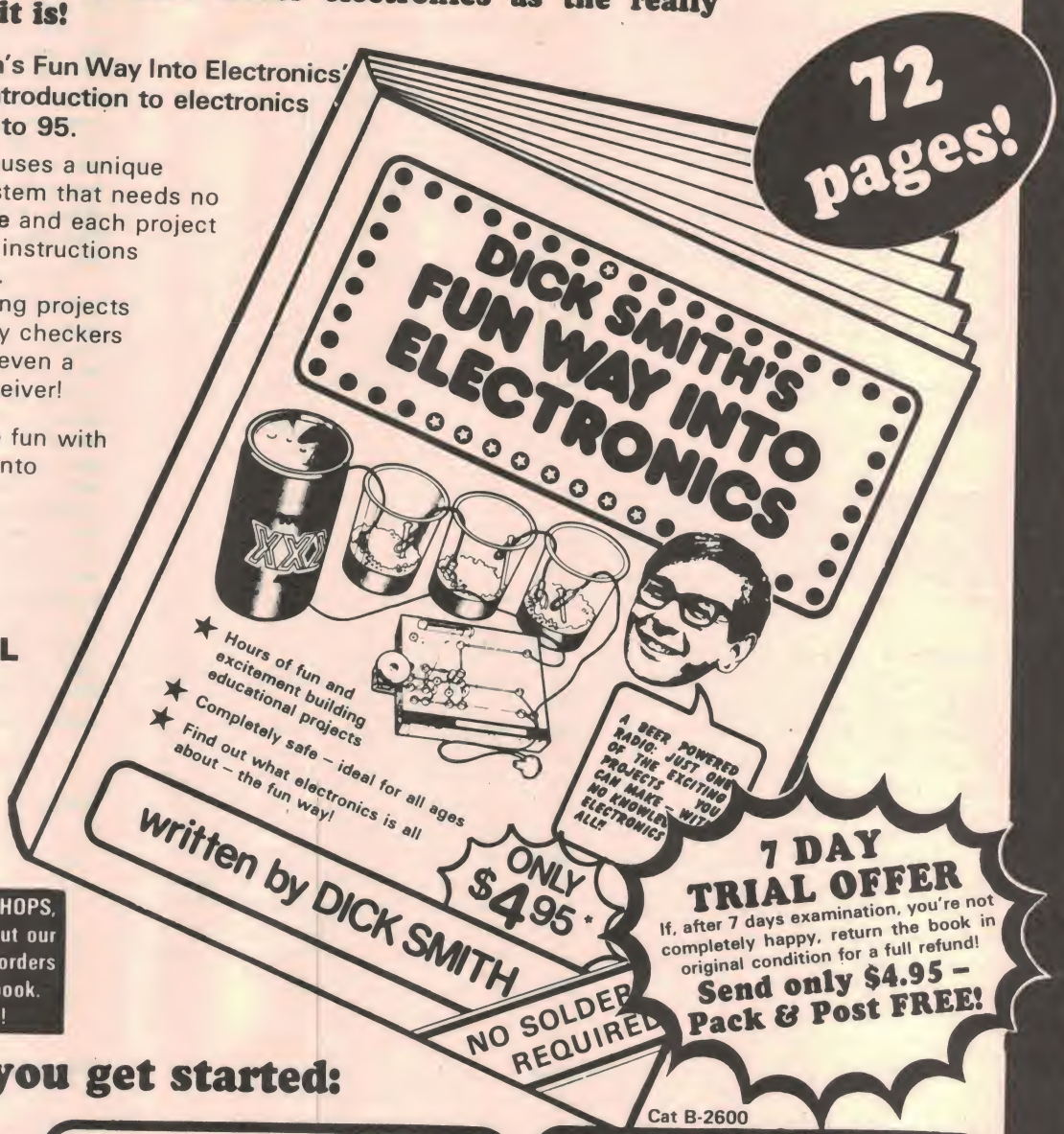

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This kit contains slightly more specialised components which, with the components in kit 1, will enable you to make the last ten projects, including radio receivers & transmitters, audio amplifiers, etc.

Contains: 10 capacitors, one variable capacitor, one potentiometer, one resistor, one signal diode, one integrated circuit, one ferrite rod aerial, one crystal earphone, one audio transformer and 70cm hook-up wire.

$7.50

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High-to-low impedance 'interface' to suit the ETI-470 60 watt amp

The popularity of our 60 watt low distortion amplifier module (May '79) has exceeded all expectations. To achieve the amplification 'accuracy' these power amps are capable of, the drive impedance must be very low — in the order of five to ten ohms. Our previous preamps, the 422 and 482, and many preamps available, generally have a medium to high output impedance and will not properly mate with the 470. This interface provides the necessary impedance conversion, allowing these amps to be used with many existing preamp designs.

Phil Wait

DESIGNED primarily for use with our Series 4000 stereo amplifier, the 470 low TID 60 watt amplifier module has found its way into the most surprising applications — from a dc motor drive to discos in central Africa. Thousands of the modules have been built, occasional output transistor shortages not withstanding, in Australia, New Zealand, Europe, Africa, Canada and the UK.

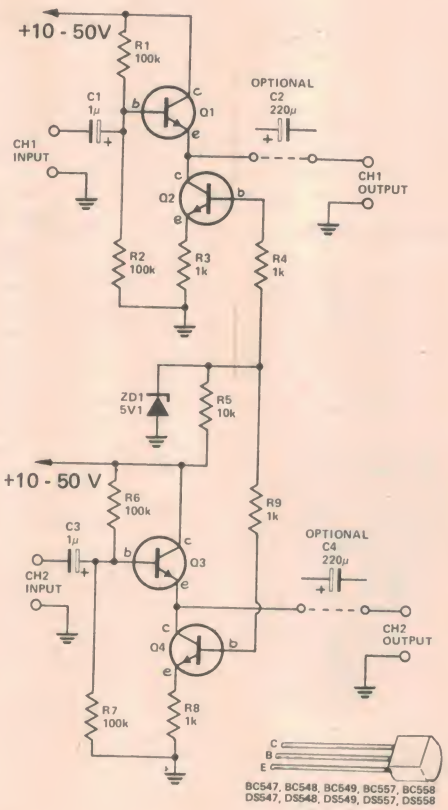
Although the 470 module was designed to be driven from a low impedance source, it is obvious from readers' letters that there are many who want to use it with existing equipment having a preamp with a high output impedance.

This project describes a two-channel (stereo) interface for driving up to two 470 modules (per channel) from a high impedance source, and can in fact be used in any application requiring a very low impedance drive at audio frequencies.

The input stage of the 470 consists of an emitter — coupled darlington pair with the input signal fed to the non-inverting input and the feedback connected to the inverting input. To reduce high frequency intermodulation the slew rate of this stage is limited by placing a 470n (0.47μ) capacitor between the two bases.

The input impedance varies with frequency, from a few thousand ohms at quite low frequencies to hundreds of ohms at the high frequencies, where the effect of the slew limiting capacitor becomes apparent.

If the stage is driven from a high impedance source, the output of the driving current will be loaded down at high frequencies by the reduced input impedance of the amplifier, causing high frequency distortion. This is why we specified a low impedance driving source for the 470, and designed our preamplifier accordingly.



Interface design

The circuit for our interface uses two emitter followers (one per channel) with constant-current generators in the emitters referenced from a zener-regulated supply voltage.

The easiest way to convert from a high impedance to a low impedance with little attenuation is with an emitter follower. The input signal is fed into the base of a transistor and the output taken from the emitter, the collector being tied to the supply. Emitter followers have a high input impedance and very low output impedance. The output impedance is roughly the value of the emitter resistor divided by the beta of the transistor.

To allow the circuit to be used with the power amplifier or with the driving source the circuit must be able to operate over a very wide range of dc supply voltages as found in graphic equalisers, organs, preamplifiers and such.

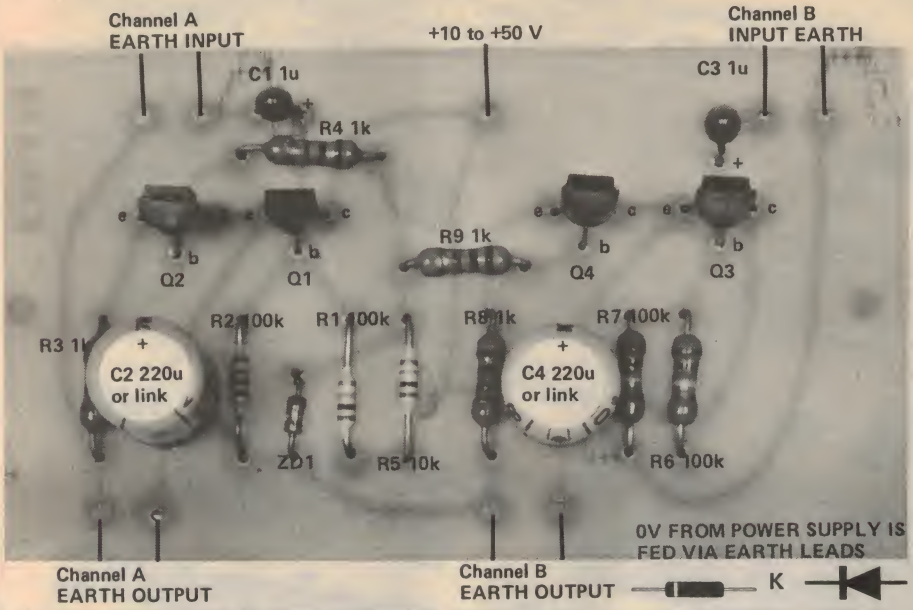
To limit the supply current and dissipation of the emitter follower when

HOW IT WORKS — ETI 474

The circuit consists of two emitter followers, Q1 and Q3, with constant current generators in their emitters. The constant current generators share the same voltage reference, ZD1.

The reference voltage, 5.1V, is derived from ZD1, and fed to the bases of Q2 and Q4. The voltage on their emitters is then set at 4.4V. The transistors will always pass the exact amount of current required to maintain this voltage on the emitters, regardless of supply voltage.

The input signal is fed to the bases through dc blocking capacitors C1 and C3, and the output is taken from the emitters directly or via the optional blocking capacitors C2 and C4. The gain of the circuit is a little less than unity.



PARTS LIST - ETI 474

Resistors all ½W, 5%
R1, R2 . . . . . 100k
R3, R4 . . . . . 1k
R5 . . . . . 10k
R6, R7 . . . . . 100k
R8, R9 . . . . . 1k

Capacitors
C1. . . . . 1μ 35V tantalum
C2. . . . . 220μ 35V electro (optional)
C3. . . . . 1μ 35V tantalum
C4. . . . . 220μ 35V electro (optional)

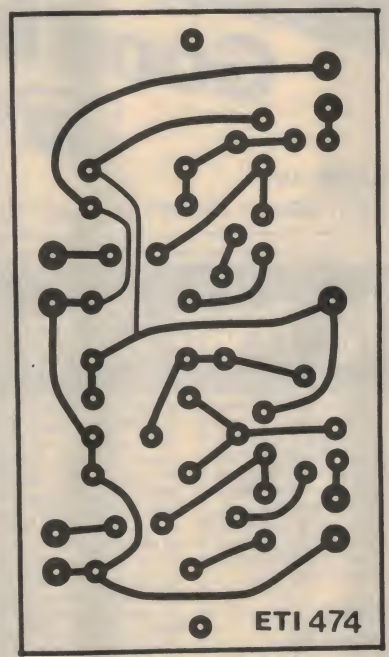
Semiconductors
ZD1. . . . . 5V1 400mW zener diode
Q1–Q4. . . . . BC107, BC547, DS547 or similar

Miscellaneous
ETI 474 pc board.

used with a high supply voltage we used a constant current generator (Q2, Q4) in each of the emitters in place of the normal emitter resistor. The use of a constant current generator also increases the input resistance and decreases the output resistance. A current of about four milliamps flows through the transistors for all supply voltages above five volts.

The output capacitors (C2, C4) provide dc isolation for the output, but since the 470 modules already have an isolation capacitor (C1), they can be left out and the pc board bridged with a length of tinned copper wire. If any other connection is made from the output, for auxilliary equipment, the capacitors should be left in.

If the capacitors are removed it will be necessary to replace the input capacitor on the 470 power amplifier



(C1) with a 220μ, 35 volt electrolytic **oriented it with its positive lead towards the input terminal.**

Construction

Construction is straightforward, the only thing to watch is the orientation of the transistors and the zener diode. The unit can be mounted with the power modules and run from their supply or mounted with the driving circuit. Input and output connections should be via shielded cables which also carry the power supply earth on the braid to avoid earth loops.

If only one power module is to be driven, as with an electronic organ, the pc board can be cut in half and only one channel assembled. ●

Hints and tips for the ETI-470 60W Module

MOST PEOPLE haven't had problems with their 470 module, but inevitably there are some who do. From calls and letters to our reader enquiry service we have identified five areas of trouble.

1) The earth rail on the amplifier must be returned to the 0V rail on the power supply. If this is not done the input transistors and their current source (Q1-Q5) will be destroyed. This is probably our failing as, although it is obvious to most people, it was not indicated on the circuit given in the May '79 issue but was indicated in the wiring diagram of the Series 4000 amplifier in the July '79 issue.

2) It can be seen from the overlay that the base lead of Q5 must be slightly bent to fit the pc board. The transistor can easily be inserted the wrong way round. Watch this.

3) The darlington output transistors **must** have a good heatsink. Always make sure the thermal contact between the transistor and the heat-sink is good. Use a thermal compound (such as Bevaloid GS13), but not too much – just a smear on either side of the mica washer. Use a metal, rather than a nylon screw with an insulating bush, to fasten the transistor – a nylon one will stretch under tension. Make sure the heatsink is smooth and flat, curved or sandblasted heatsinks will not make good thermal contact with the transistor body.

4) Make sure that the transistor Q8 has a good thermal contact to the heatsink. It must be the same heatsink as the output transistors.

5) Never, never run the amp without a heatsink, even if only to set the bias.

Overheating of the output devices due to poor heatsinking will result in thermal run away which will blow the fuses but will probably not damage the output transistors provided the two amp fuses are in circuit. Faults where the amplifier operates correctly for a while then blows fuses, will probably be due to poor heatsinking.

Most transistors in the amplifier are designed to run quite warm in normal operation.

No problems have become apparent with the preamplifier (ETI-471).

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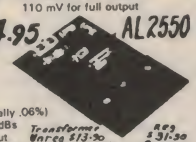

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Output Power THD 1%	50 watts min
Supply Voltage Max	70 Volts
Operating Voltage Range	50-70V
Load	8-16 ohms (see note 1)
Frequency Response ± 1 dB	25Hz-20kHz
Sensitivity for 50 watts into 8	500mV
Input Impedance	35 K ohms
T.H.D. at all power levels	.05% max (Typically .02%)
S/N Ratio	100 dBs

125w AMP **AL12580** $59.95
Transformer Unreg or Reg Mono $37.50 Stereo $47.50

Max. Output power	125 watt RMS
Operating voltage	50-80 Max
Loads	4-16 ohms
Frequency response	25Hz — 20kHz at 100 watts
Sensitivity for 100 watts	450mV
Input impedance	33k ohms
Typical T.H.D. 4 ohms load	0.1%
@ 50 watts 8 ohms load	0.06%
S/N ratio	better than 80dBs

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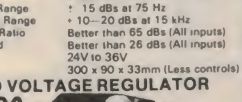

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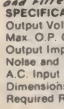
Noise and Ripple at 2A	Less than 15 mVrms	
A.C. Input Voltage	40-48V	60-65V
Dimensions	149 • 83 • 37mm	
Required Reservoir Capacitor	2,200uF	3,300uF



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12 Miniature PCB RELAYS DPDT 48v operation, ITT made (coil .5K Ω 50v but easily rewound) 50c
13 REED RELAYS- 1amp SPST reed switch cutout at about 70°c 50c
14 COMPUTER BOARDS- some with power transistors, small signal diodes, res, caps, electros etc 10c, 20c, 50c ea.
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16 Small MOTORS, 110v or 240v with resistor- turntable type, new 50c
17 1 RPM GEARED MOTORS, 110v or 240v with resistor $1.00
18 Thermodisc Temperature Cutout SWITCH 50c
19 FERRITE RODS 6" x 3/8" diam. only 25c ea, 10 for $2.00
20 ¼" Tape or Cassette SPLICERS- new, easy-to-use, were $3.95, save 50% 2.00
21 3" 300ft REEL TAPES- also other sizes too! All just 20c
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24 Mono Turntable CARTRIDGE 90c or Stereo only $1.90
25 10 Trimmer CAPACITORS- usefull types, ceramic etc. 10 for 75c
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27 40 asst. RADIO/TV/Amplifier KNOBS- real handy! $1.00
28 20 asst. POTENTIOMETERS- sgle, dual, ganged, switch $1.00
29 45 asst. ELECTROLYTICS- all usefull, PCB and Pigtail $1.00
30 250 ¼, ½, 1 Watt RESISTOR PAK- asst values $2.00
31 50 asst. TAGSTRIPS- up to 9 lug, were $2.00, now $1.00
32 20 asst. DIAL LIGHTS- 6v, 12v, 24v, 50v etc, were $2— 75c
33 PL-259 PLUGS- new! 50c
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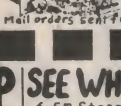
7" x 3" 50Ω or 100Ω $1 or 10 for $8



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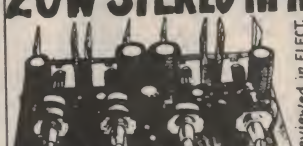

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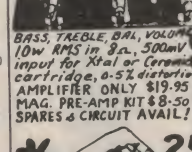

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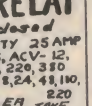

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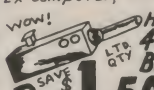

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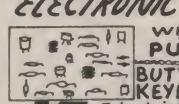

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7422	.35
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7430	.30
7432	.30
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7438	.40
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7440	.30
7442	.80
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7448	1.10
7450	.30
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7453	.30
7454	.30
7460	.30
7470	.50
7472	.55
7473	.55
7474	.35
7475	.45
7476	.40
7480	1.00
7483	1.40
7485	1.40
7486	.55
7489	2.90
7490	.40
7491	1.00
7492	.80
7493	.50
7494	1.15
7495	1.00
74100	2.00
74107	.70
74121	.70
74123	.85
74132	1.30
74145	1.50
74150	1.50
74151	1.40
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74154	1.40
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74172	1.40
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74LS30	.30
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74LS42	.45
74LS73	.60
74LS74	.40
74LS75	.50
74LS78	.65
74LS85	1.40
74LS86	.60
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74LS92	1.00
74LS93	.85
74LS95	1.00
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74LS114	.55
74LS125	.70
74LS133	.70
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74LS157	.75
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74LS163	.80
74LS164	1.40
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74LS192	1.15
74LS193	1.00
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74LS196	1.60
74LS197	1.60
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4021	1.30
4022	1.30
4023	.30
4024	1.00
4025	.30
4027	.70
4028	1.00
4029	1.40
4035	1.20
4040	1.40
4042	1.20
4043	1.00
4044	1.00
4046	2.20
4049	.70
4050	.75
4051	1.20
4052	1.20
4053	1.20
4060	1.50
4066	.90
4068	.35
4069	.30
4070	.30
4071	.30
4072	.30
4076	1.75
4077	.30
4078	.30
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4082	.30
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78L09	.40
78L12	.40
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MCT2	1.20

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SC141D	1.30
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SEL303E M/G	.40
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SKNY(BEZEL)Y	1.80
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0.15uf 35V	.20
0.22uf 35V	.20
0.33uf 35V	.20
0.47uf 35V	.20
0.68uf 35V	.20
1uf 35V	.20
1.5uf 35V	.20
2.2uf 35V	.20
3.3uf 35V	.20
4.7uf 16V	.20
4.7uf 35V	.30
6.8uf 35V	.30
10uf 25V	.25
10uf 35V	.30
15uf 35V	.55
22uf 16V	.30
22uf 35V	.74
33uf 10V	.30
47uf 6.3V	.40
47uf 16V	.55

MIN. CERAMIC

1pf-0.03	.06
0.047	.08
0.1uf	.12
0.22uf	.20
0.47uf	.25

POLYESTER

100V

.001-.027	.10
.033-.056	.12
.068-.1	.16
.12-.22	.30

250V

0.27uf	.30
0.33uf	.34
0.39uf	.48
0.47uf	.50
.56,.68,.82	.60
1,1.2,1.5	1.00
1.8uf	1.20
2.2uf	1.40
3.3uf	2.10
4.7uf	3.50

TRIM. CAPACITORS

0.4pf-5.5pf	.30
2pf-22pf	.40
5pf-65pf	.30
5.5pf-40pf	.40

ELECTROLYTIC. PCB.

6.3V	470uf	.20
	1000uf	.30
10V	4.7,100uf	.10
16V	10uf	.08
	22,33,47uf	.10
	100uf	.15
	220,330uf	.20
	470uf	.25
	640uf	.45
	1000uf	.40
	2500uf	.65
25V	2.2,3.3uf	.10
	4.7,10uf	.10
	25,33uf	.12
	47uf	.13
	100uf	.15
	220uf	.20
	330uf	.25
	470uf	.35
	1000uf	.50
	2200uf	.90
35V	2.2,3.3uf	.10
	10uf	.15
	100uf	.20
	220uf	.30
	1000uf	.70
	2000uf	.90
	2200uf	1.10
50V	.47 1 2.2	.08
	3.3 4.7 10	.15
	22 33 47	.20
	100uf	.20
	220uf	.50
	470uf	.60
63V	.47 1 2.2	.10
	3.3 4.7uf	.10
	10 25uf	.15
	47uf	.20
	100uf	.25
	220uf	.40
	330uf	.45
	470uf	.80

ELECTROLYTIC RT. (DOUBLE ENDED)

16V	33uf	.15
	330uf	.40
25V	100uf	.25
	330uf	.45
	2500uf	1.00
50V	2500uf	2.15
63V	10uf	.16
	47uf	.30
	100uf	.40
	220uf	.65
	470uf	.75

(CAN TYPE, RG/D/P)

2500uf 35V	1.60
5600uf 40V	2.40
3300uf 75V	5.90
6800uf 50V	5.20
2500uf 35V	1.95

RESISTORS

0.33W 1Ohm-10M in E24 Series	.03
1W 1Ohm-1M. in E12 Series	.07
5W wirewound(E12) 0.1 Ohm-4.7K	.25
0.4W 2% 1Ohm-1M E12 Series	.10

MINIATURE TRIMPOTS

100,250,500,1K,2K,5K, 10K,25K,50K,100K, 250K,500K,1M, all	.20

BI-Polar Electro. (all 50V)

1uf, 2.2uf	.25
3.3uf, 4.7uf	.30
6.8uf	.30
10uf, 22uf	.40
33uf	.50
47uf	.69
100uf	.80

Min. "Cermet" Trimpots Vert. & Horizontal. all 52

Polystyrene 125V

10,15,22,33,47,68,100, 150,220,330,390,470, 680pf	.45
1000,1500,2200,3300, 4700,6800,10000pf	.55

Computer Grade Electrolytic

2900uf 40V	6.75
6800uf 16V	6.48
10000uf 16V	9.00
10000uf 25V	9.72
10000uf 40V	13.50
15000uf 40V	12.06
22000uf 25V	14.22
22000uf 40V	23.40
27000uf 35V	24.48
33000uf 16V	13.50
68000uf 16V	22.32
1000000 10V	22.32

POLYPROPOLENE (HIGH CURRENT)

0.047uf 400V	.40
0.056uf 400V	.40
0.47uf 200V	.90

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0.5uf(Gen)	1.00
3uf (Alt)	2.80
15Kohm(Dist)	.75
15Kohm(S/P)	1.10

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16 Way	1.85
24 Way	2.95
32 Way	3.80

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3½"	.06
5½"	.07

Enamelled Copper Wire (2&4 oz reels, B&S)

16,21,29	1.70
18,30	5.20
20,24	3.60
22	1.80
26	3.70
28	4.50
31	5.60
32	5.50
33,34	6.10
36,37	3.30
38,39,40	3.30

POTENTIOMETERS

Single Rotary Log or Linear	.70
Dual Rotary Log or Linear	1.60
Single Rotary with DPST switch	1.80
Slider Linear	1.10

MULTITURN TRIMPOTS

10,20,50,100,200,500, 5K,50K,500K,1M, 2M	1.45

AUDIO MODULES

S1-1010G 10W	10.80
S1-1020G 20W	21.90
S1-1030G 30W	27.75
S1-1050G 50W	42.38
HY5 stereo pre	33.00
HY50 25W	42.00
HY120 60W	95.00
HY200 100W	133.00
HY400 240W	180.00
OM350	7.90
LM379S	6.90

IC SOCKETS

8 pin	.20
14 pin	.25
16 pin	.28
18 pin	.65

Lab Notes

An occasional series in which we discuss interesting circuit techniques, circuits we have tried in our own laboratory but not developed as a project, practical notes on projects, measurement techniques for hobbyists etc.

A little light on LEDs

This month Ray Marston, project editor of ETI, UK edition, has provided some interesting notes on LEDs and how to use them.

Basic characteristics

SOMETHING that we all know about the LED is that it glows a pretty colour if we shove a bit of current through it. LEDs are presently available in four colours, red, orange, yellow and green. Blue LEDs will also be available in the near future. A voltage is developed across the LED when it is passing a forward current. Figure 1 shows typical forward voltage of different coloured standard LEDs at forward currents of 20 mA.

COLOUR	RED	ORANGE	YELLOW	GREEN
VF (TYPICAL)	1.8V	2.0V	2.1V	2.2V

Figure 1. **Typical forward voltage characteristics of standard LEDs with forward current set at 20 mA.**

When you use an LED, you have to wire some form of current-limiting device in series with it. Usually, a resistor can be used for current limiting. Figure 2 shows how to work out the value of resistance to give a particular current from a specific supply voltage: in practice, 'R' can be connected in either the anode or cathode side of the LED. The higher the operating current, the brighter the LED will glow. Most LEDs will operate safely up to absolute maximum currents of 30 to 40 mA.

You can use an LED as an indicator in an ac circuit by wiring a diode in inverse parallel with it, as shown in

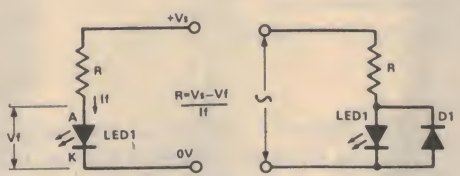


Figure 2. **(Left). Finding the required series resistance from a known supply voltage.** *Figure 3.* **(Right). Using a LED as an indicator in an ac circuit.**

Figure 3, to prevent the LED being reverse-baised. For a given brightness, the value of 'R' should be halved relative to that of a dc circuit.

If an LED is reverse biased, it will avalanche or 'zener' at a fairly low voltage, as shown in Figure 4. Most LEDs have maximum reverse-voltage ratings in the range three to five volts. These low ratings present a trap for the unwary user, so take heed.

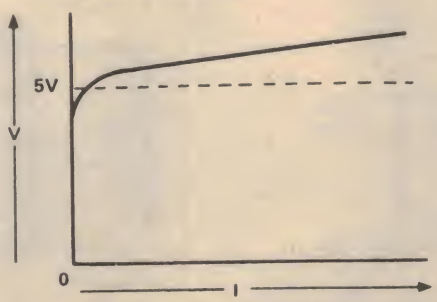


Figure 4. **A reverse-biased LED will have characteristics similar to a zener with a 'knee' around five volts.**

Pitfalls

The first practical problem that you'll encounter when using an LED is that of identifying its polarity. Most LEDs have their cathode identified by a notch or flat on the package, or by a short lead. This practice is not universal, however, so the only sure way to identify an LED is to test it in the basic circuit of Figure 2: try the LED both ways round. When it glows, the cathode is the most negative of the two terminals. It is always good practice to test an LED before soldering it into circuit.

The second pitfall concerns the use of those 'cheapo' LEDs that come in Bargain Packs. These are usually advertised as 'second grade' or 'out of spec' devices, but just how out-of-spec they are can sometimes be quite mind blowing. You'll often find that half of the devices in a pack have forward voltages in the range five to eight volts, which makes them virtually useless in many applications.

If you ever need to drive a number of LEDs from a single currently available 'dot' or 'bar' LED-display driver ICs, always check its spec to see if it is sensitive to LED characteristics. The Siemens UAA170 15-LED 'dot' driver, for example, will only function correctly if all LED forward voltages are matched to within 0.5 volts, and can thus be used with first grade LEDs only. ▶

Lab Notes

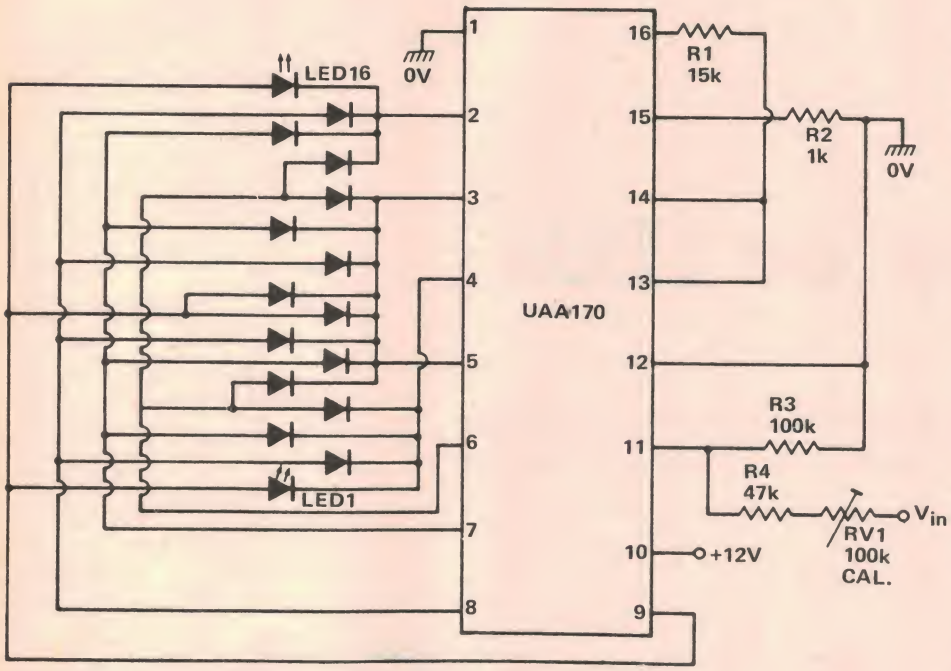


Figure 5. **This circuit shows a 0 to 10 V voltmeter using a Siemens UAA170 IC. For correct operation, the forward voltage of each LED must be matched to within 0.5 V and thus first grade LEDs only may be used.**

Figure 5 shows the circuit of a 0 to 10 volt 16-LED voltmeter using this IC.

Driven to it

If you ever need to drive a number of LEDs from a single source, take notice of the circuits in Figures 6 to 9. Figure 6 shows how a number of LEDs can be wired in series and driven via a single current-limiting resistor. Note that the supply voltage used here must be significantly greater than the sum of the individual LED forward voltages. This circuit thus draws minimal total current, but is limited in the number of LEDs that it can drive.

The Figure 7 circuit, on the other hand, can drive an unlimited number of LEDs, but is very wasteful of current. The total current drawn is equal to the sum of the individual LED currents.

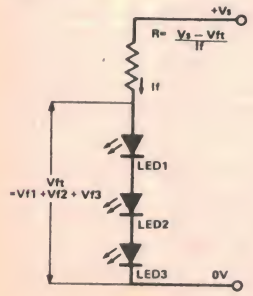
Figure 8 combines the Figure 6 and 7 circuits to give the best of both worlds. The circuit can drive an unlimited number of LEDs, at maximum current economy.

Figure 9 illustrates one of those 'traps for the unwary', or 'what not to do' circuits. This circuit will not function correctly because inevitable differences in the forward voltage characteristics of the LEDs will usually cause one LED to 'hog' most of the available current, leaving little or none for the remaining two.

Chasers

The highly popular CD4017B decade counter with 10 decoded outputs is widely used for driving LED displays in chaser or sequencer applications. A certain amount of confusion seems to exist, however, concerning the 'correct' method of connecting the LEDs to the decoded ouputs.

The decoded outputs of this CMOS device provide inherent current-limiting under short-circuit conditions. The manufacturers do not quote a maximum short-circuit current value, but practical experience indicates that currents of 10-10-15 mA are commonly available from the 'B' version of the 4017. A maximum device dissipation per output transistor figure of 100 mW is quoted on some data sheets, indicating that a volt drop



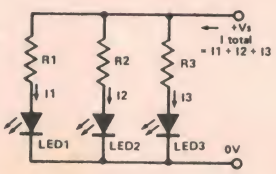
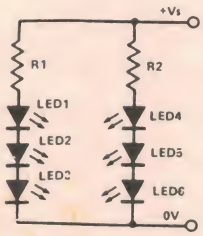


Figure 6. **(Left). How to determine the series resistor value required for LEDs wired in series and driven from a single supply.**
Figure 7. **(Right). You can drive a whole host of LEDs from one supply rail — provided you can source the current required.**



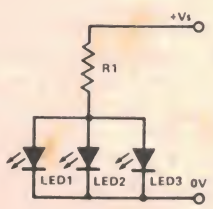


Figure 8. **(Left). This is a combination of the circuits in Fig's 6 & 7.**
Figure 9. **(Right). How NOT to do it — one LED hogs all the current.**

up to about seven volts can safely be developed across a 4017 output stage under maximum-current conditions.

Thus the LED chaser circuit of Figure 10, this has each LED connected directly between an output and ground and can safely be used up to maximum supply values of 9 volts. At voltages greater than 9 volts, the circuit of Figure 11, which has a resistor wired in series with each LED, should be used. Note that the main purpose of these resistors is that of reducing the power dissipation of the 4017B.

A variant that is sometimes used is shown in Figure 12a, and can be used with reasonable confidence at supply levels up to 12 volts maximum. Figure 12b shows a possible equivalent of this circuit when it is powered from a 15 volts supply, and illustrates the defect of the design. The action of the 4017 is such that when a given LED is ON, the anodes of all other LEDs are effectively grounded. R1 thus causes the OFF LEDs to be reverse biased. Because of the low reverse-voltage ratings of LEDs, it will often be found that one of the OFF LEDs will Zener at about five volts, giving the results shown in the diagram and possibly causing a destructive power overload in one of the 4017B output stages. Figure 12 thus represents a classic 'trap for the unwary' type of LED circuit. ●

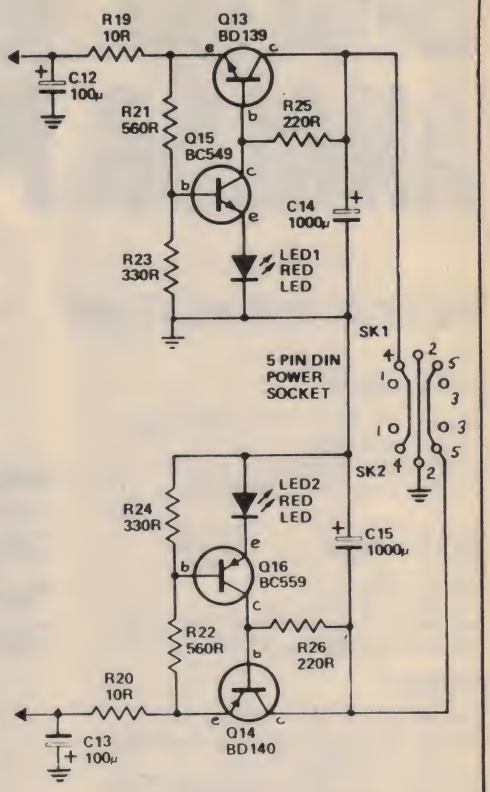
The LED as a regulator

A LOW NOISE regulator can be made using an LED as the reference element. David Tilbrook used this technique in the Series 4000 moving-coil preamp (ETI-473, Sept '79).

The usual reference elment for discrete voltage regulators is a zener. As these devices operate in the reverse-biased mode, they are inherently noisy and will put noise on the regulated supply rail. This is likely to degrade the performance of low-noise, low-level circuits supplied by the regulator.

The circuit of the +/–6V regulated supply for the ETI-473 moving-coil preamp is reproduced here. A red LED operated in the forward-biased mode drops a constant 1.65 V and generates very little noise. The reference LEDs in the circuit here are LED1 and LED2. Series regulators Q13 and Q14 regulate the incomeing +/–12V. The potential dividers R21/R23 and R22/R24 divide the voltage present at the output of the regulators and drive transistors Q15 and Q16, and the LEDs. The base-emitter junction in series with each LED will drop 0.6 V; to this is added the LED forward drop of 1.65 V. Thus, whenever the voltage present at the junction of the voltage divider resistors tries to increase above 2.3 V, Q15 and Q16 will increasingly conduct, decreasing drive to the bases of Q13 and Q14 respectively.

Noise on the regulated supply rails is further reduced by the C-R networks, C12/R19 and C13/R20.



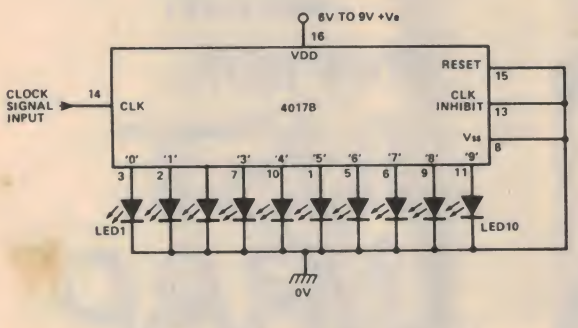


Figure 10. **A typical LED chaser circuit using a CMOS chip, the 4017B.**

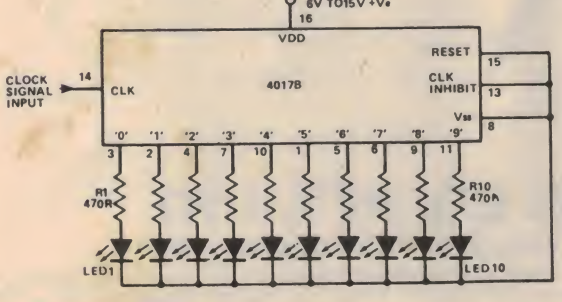
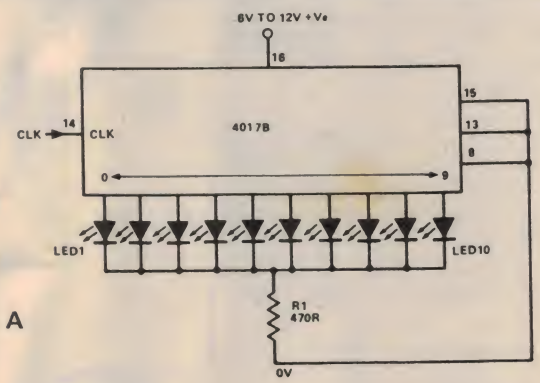


Figure 11. **For supplies over 9V, use this circuit instead of Figure 10.**



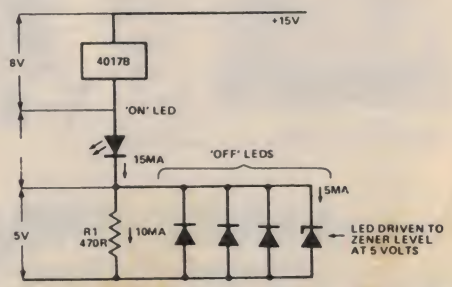


Figure 12. **The complete circuit at top may be used with supplies up to 12V but contains a trap for the unwary – at 15V, the 'off' LEDs will be biased into their zener region.**

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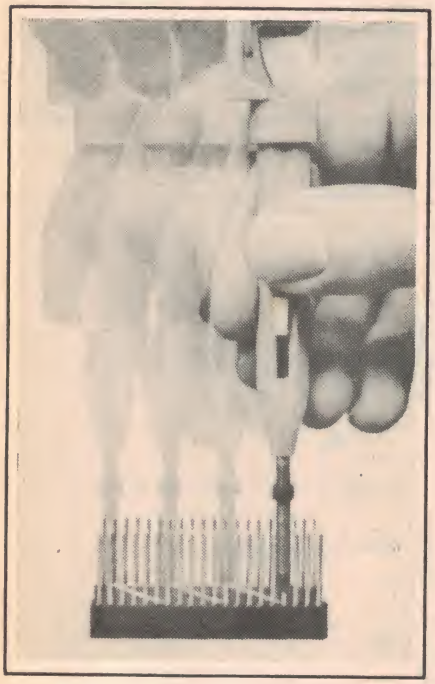

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Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.

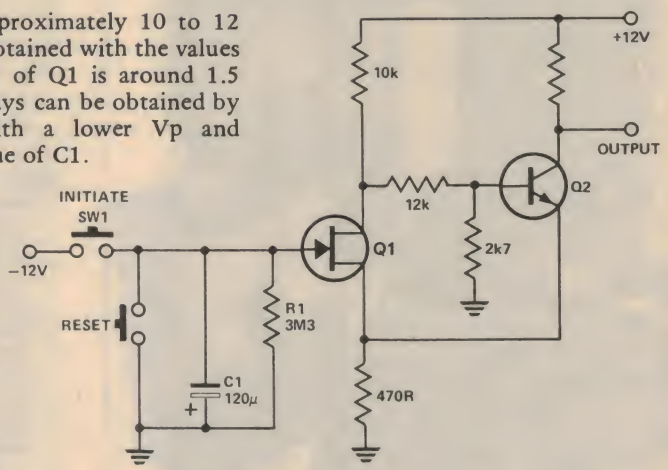
Ten-minute timer

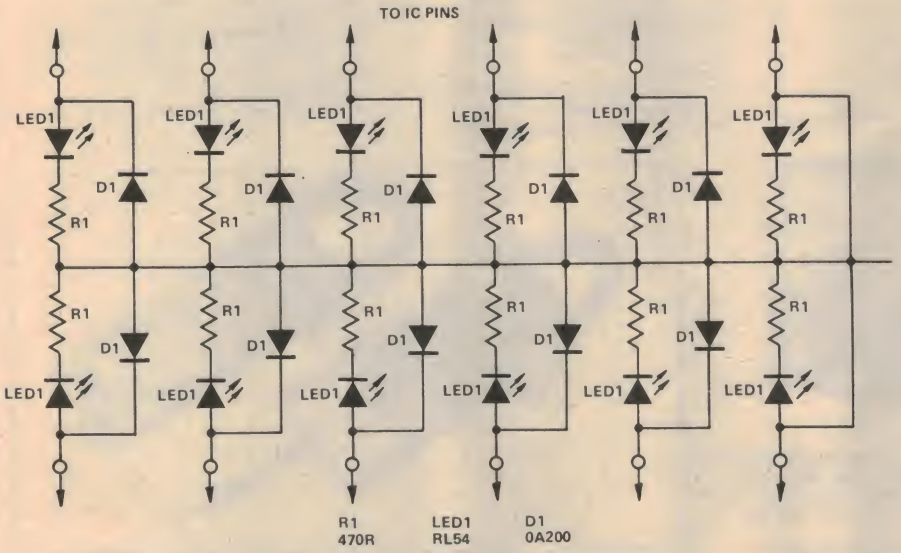
Curiously, this one was sent in by Roger Harrison many years ago and has only just surfaced!

The circuit is a hybrid Schmitt trigger, using a FET and a bipolar transistor. Initially, Q1 will be on and Q2 will be off. The output will be high (+12V). The timer is initiated by pressing S1. C1 will rapidly charge to −12V and Q1 will be cut off. Q2 will then turn on.

When S1 is released, C1 discharges through R1 until the voltage across C1 equals Vp of Q1. The circuit will now change state and Q2 will turn off rapidly, providing a suitable output step which can be used to operate a relay driver or any external circuit.

A delay of approximately 10 to 12 minutes can be obtained with the values shown if the Vp of Q1 is around 1.5 volts. Longer delays can be obtained by using a FET with a lower Vp and increasing the value of C1.





LED 'logicator'

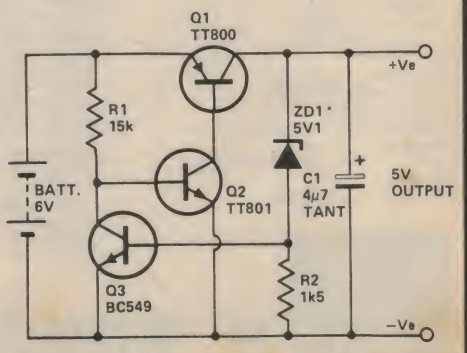
This circuit, submitted by Michael Kyrannis of Pascoe Vale Vic, can be used as a logic monitoring device to plug into an IC socket. A 'high' level on each of the pins will light its corresponding LED. One good idea might be to build the indicator onto the pins of an IC test clip. The indicator could then be simply clipped over the top of an operating IC. Be careful though that the circuitry can drive the LEDs.

Stabiliser for battery supplies

The accompanying circuit is useful when voltage sensitive devices (such as TTL ICs) must be battery operated. It uses very little power from a good battery, whilst with a flat battery, the output voltage is within 0.1 V of the battery voltage. ZD_1 should be selected to obtain approximately the desired output voltage; for fine trimming, R_2 may be selected between 470 ohms and 3k3. With the components shown, the output voltage varies less than 2% for battery voltages from 5V to 8V and output currents from zero to 200 mA. For higher currents, R_1 may need to be decreased.

Always use a power transistor for Q_2, or it will overheat when the battery is nearly flat. Both Q_1 and Q_2 should have a current gain of at least 40, while the gain of Q_3 should be as high as possible.

You can thank Mr F.C. Gillespie of Findon, S.A., for this neat idea.



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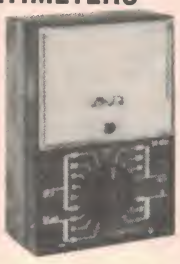
200 & 1000 V ranges: acc. ± 1.5%rdg ± 0.1%f.s. ± 1dgt
D.C. AMPERAGE 4 ranges. With auto facility
200 & 2000 μA ranges: acc. ± 1.0%rdg ± 0.1%f.s. ± 1dgt.
20 & 200 mA ranges: acc. ± 1.0%rdg ± 0.1%f.s. ± 1dgt.
A.C. VOLTAGE 5 ranges. With auto facility.
2000 mV range: acc. ± 0.3%rdg ± 0.2%f.s. ± 1dgt
20-200 Volts range. acc. ± 0.8%rdg ± 0.7%f.s. ± 1dgt.
200 Volts range: acc. ± 1.7%rdg ± 0.8%f.s. ± 1dgt.
1000 Volts range: acc. ± 1.7%rdg ± 0.3%f.s. ± 1dgt.
A.C. AMPERAGE 4 ranges. With auto facility
200 μA acc. ± 1.3%rdg ± 1.0%f.s. ± 1dgt.
2000 μA acc. ± 1.3%rdg ± 0.2%f.s. ± 1dgt.
20 & 200 mA ranges: acc. ± 1.3%rdg ± 0.7%f.s. ± 1dgt.
RESISTANCE (OHMS) 6 ranges. With auto facility.
200 & 2000Ω ranges: acc. ± 0.5%rdg ± 0.1%f.s. ± 1dgt.
20 & 2000kΩ ranges: acc. ± 0.5%rdg ± 0.1%f.s. ± 1dgt.
2-20mΩ acc. ± 0.7%rdg ± 0.2%f.s. ± 1dgt.
DIMENSIONS (Approx)
151 mm H. x 100 mm W. x 56 mm D. Weight 470g.

MULTIMETERS



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Full Scale Value 0.25/2.5/10/50/250/1000V.
Accuracy ± 3% of rated value.
Internal Resistance 2000Ω/V.

D.C. AMPERAGE
Full Scale Value 0.5/10/250mA.
Accuracy ± 3% of rated value.
Voltage Drop 250mV.

A.C. VOLTAGE
Full Scale Value 10/50/250/1000V.

RESISTANCE (OHMS)
Full Scale Value 3k/30k/300kΩ (Rc 26Ω)

DIMENSIONS
130 mm H. x 90 mm W. x 53 mm D. Weight 305g.

ACCESSORIES
Carry case, test leads, spare fuse.

3010 An ultra sensitive meter–100,000Ω/V. (Max). Includes D.C. polarity selector switch, relay and fuse protection, a taut band movement plus an output terminal for dB readings.

D.C. VOLTAGE
Full Scale Value 0.1/1/2.5/10/50/250/1000V
Accuracy ± 3% of rated value.
Internal Resistance 100.000Ω/V

D.C. AMPERAGE
Full Scale Value 10μ/100μ/1/10/100/500 mA./10A
Accuracy ± 3% of rated value.
Voltage Drop 100 mV. 250 mV

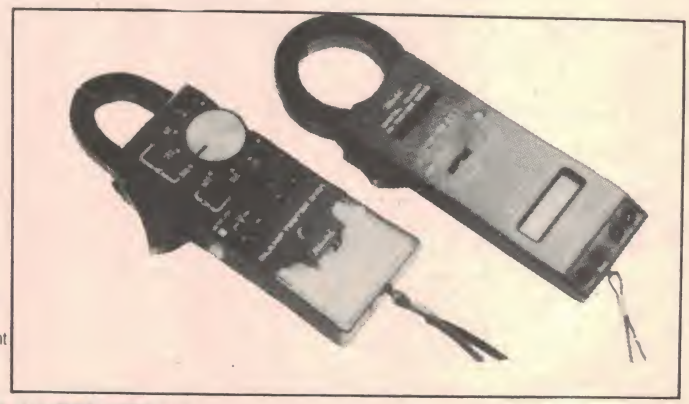
A.C. VOLTAGE
Full Scale Value 10/50/250/500/1000V.
Accuracy ± 3% of rated value
Internal Resistance 10,000Ω/V.

A.C. AMPERAGE
Full Scale Value 10A.
Accuracy ± 4% of rated value.

RESISTANCE (OHMS)
Full Scale Value 2k/200k/2m/20mΩ (Rc 20Ω)
Accuracy ± 3% of scale length.

LOW FREQUENCY OUTPUT (DECIBELS)
−20 +36 dB.

DIMENSIONS
170 mm H. x 126 mm W. x 70 mm D. Weight−690g.



CLAMPTESTERS

3101 Dustproof case; circuit protection fuse and convenient meter lock. Incorporates the advanced, shock-resisting core magnet taut band movement

A.C. AMPERAGE
6/15/60/150/300A
Accuracy ±3% of rated value

A.C. VOLTAGE
150/300/600 V
Accuracy ±3% of rated value

RESISTANCE (OHMS)
0-1 kΩ (Centre 30Ω)
Accuracy ±3% of scale length.

DIMENSIONS
210 mm H. 86 mm W. 42 mm D. Weight 400 g.

ACCESSORIES INCLUDED
Carry case, test leads, spare fuses, alligator clip

3206 DIGITAL CLAMP TESTER A "Field Effect" type liquid crystal display ensures good contrast for low power consumption–approx. 100 hours continuous use with alkaline batteries. Features include auto range selection, peak hold and display hold facilities.

READING RANGE
A.C. AMPERAGE
0-20 amp range, 200 and 1000 amps max.
A.C. VOLTAGE
0-1000 volts.
RESISTANCE (OHMS) 0-2000Ω
DIMENSIONS (Approx)
230 mm H. x 80 mm W. x 38 mm D. Weight 450g.
ACCESSORIES INCLUDED
Carry case, test leads, spare fuse, alligator clip.

H.ROWE & CO PTY LTD

H. ROWE & CO. PTY. LTD.

54 Racecourse Road, North Melbourne. Ph. 329 6511

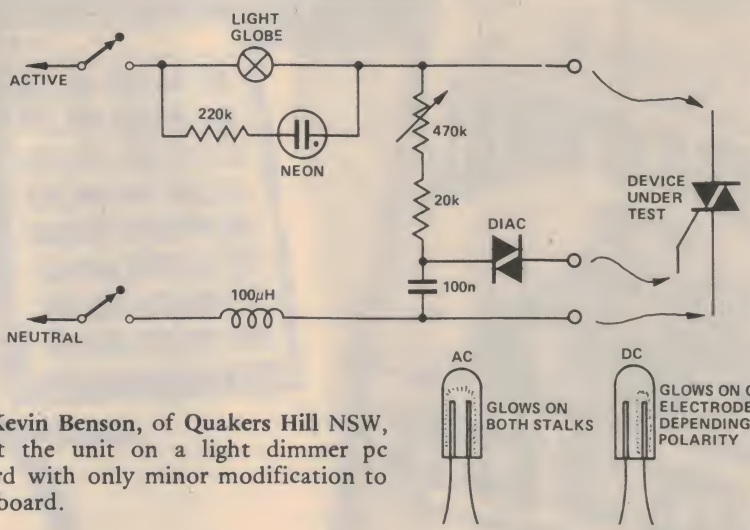
SOLE AUSTRALIAN AGENTS

adelaide brisbane melbourne perth sydney

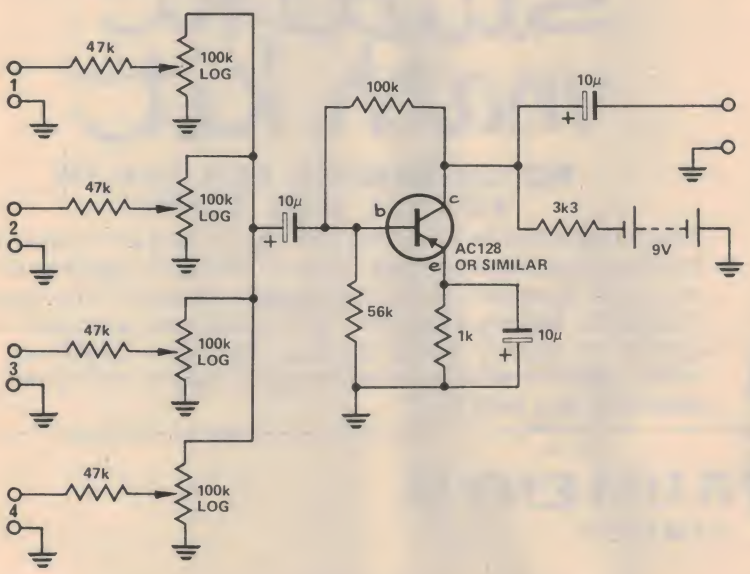
Ideas for Experimenters

Triac tester

This circuit was made to fill a need to quickly test triacs under a light load. By observing the neon it is possible to tell whether ac or dc is flowing through the light-globe. The device to be tested is connected to the circuit with clip leads and the 470k potentiometer advanced until the globe lights. If the neon glows on both stalks the globe is fed with ac and the triac is working properly. If one stalk only glows, one cycle of the waveform is passing through the globe signifying a fault with one junction of the triac. Of course, if it doesn't glow at all and the light is not lit, the triac is completely faulty.



Kevin Benson, of **Quakers Hill** NSW, built the unit on a light dimmer pc board with only minor modification to the board.



Four-input mixer

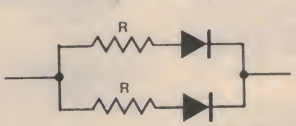
Mr D. Marzolla of Leichhardt claims that this mixer circuit has very low current drain and can give an operating life of three to four months from a No. 216 9-volt battery with moderate use.

The input impedance is 47k and the gain of the mixer is 3 dB. Perhaps a good use for those old germanium transistors you were going to throw out but knew they would come in handy sometime!

Current-sharing for diodes

The current handling capacity of a diode can be increased by adding a second diode in parallel. However no two diodes have exactly the same characteristics. This will result in one of the diodes taking more than its share of the current and destroying itself.

If a small value resistor is put in series with each of the diodes the effect of differing junction resistance will be swamped by the external resistor and the current will divide equally between the diodes. The resistors should be selected for a one volt peak drop across them and, at one amp, would require a one ohm one watt resistor.



Mr G. A. Bundell of Nedlands, Perth shows how it is done.

Any ideas?

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.

- SCIENTIFIC CALCULATOR USING AOS™ (ALGEBRAIC OPERATING SYSTEM)
- 48 CALCULATOR FUNCTIONS
- FOUR MEMORY FUNCTIONS
- FULL TRIGONOMETRIC & LOGARITHMIC FUNCTIONS
- SQUARE, SQUARE ROOT, POWER OF AND POWER ROOTS
- FIFTEEN LEVELS OF PARENTHESES
- TEN DIGIT DISPLAY WITH SCIENTIFIC NOTATION
- CONSTANT OPERATING MODE
- PERCENTAGE FUNCTION
- BATTERY SAVING MODE

TI-30 student math kit

All at the very affordable price of

$26 inc. tax **$23.90 TAX FREE**

RECOMMENDED FOR USE IN SCHOOL AND EXAMS

Texas Instruments colourful and fun-to-read 224-page "Great International Math on Keys" book provides fast access to facts you need to solve high school, college, home and career math problems. Battery-operated TI-30 slide-rule calculator is designed to quickly solve complex problems anywhere. And sturdy denim-coloured vinyl carrying case protects the TI-30 wherever you take it.

TEXAS INSTRUMENTS
AUSTRALIA LIMITED

Calculator distributors:

NEW SOUTH WALES
A.J.F. Systems & Components, 29 Devlin St., Ryde. 808-2555. Email Limited (Metering Division), Joynton Ave., Waterloo. 699-0033. Silicon Valley, 23 Chandos St., St. Leonards. 439-2965. Dick Smith Electronics, 24 Carlotta St., Artarmon. 439-5311.

VICTORIA
A.J.F. Systems & Components, 310 Queen St., Melbourne. 67-9702. Delta Scientific Product Distribution, Red Bank Court, St. Albans. 366-3742. Email Limited, 30 Clairmont Ave., West Bentliegh. 557-2944. Silicon Valley, 380 Bridge St., Richmond. 429-4780. Silicon Valley, 308 Whitehorse Rd., Blackburn. 877-5311. Dick Smith Electronics, 399 Lonsdale St., Melbourne. 67-9834.

SOUTH AUSTRALIA
A.J.F. Systems & Components, 44 Prospect Rd., Prospect. 269-1244. Email Limited, 279 Grote St., Adelaide. 51-0411. Silicon Valley, 170 Sturt St., Adelaide. 51-4080. Dick Smith Electronics, 203 Wright St., Adelaide. 212-1962.

WESTERN AUSTRALIA
Esdailes of Cloisters, 863 Hay Street, Perth. 321-9232. Silicon Valley, 25 Brisbane St., Perth. 328-8091. Dick Smith Electronics, 414 William Street, Perth. 328-6944.

QUEENSLAND
Email Limited, 407 Stanley St., Brisbane. 44-0281. Silicon Valley, 22 Ross St., Newstead. 52-1339. Dick Smith Electronics, 166 Logan Rd., Buranda. 391-6233.

TASMANIA
J. Walch & Sons, 130 MacQuarie St., Hobart. 34-7511.

NEW ZEALAND
David Reid Data Products, 17 Huron St., Takapuna, Auckland. 49-9197.

KITS for projects

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish. This list is a guide to suppliers of kits and components for ETI projects.

We have only listed the projects published in the last two years, with their dates of publication, so this page can also be used as an index, even though kits are not available for some of them (as far as we know). Any companies who wish to be included in this list should phone Jan Collins on 334282.

Printed circuit boards

Those suppliers listed against specific projects here are able to supply pc boards for those projects. Printed circuit boards for every project evér published in ETI are available through the following companies (to the best of our knowledge):

RCS Radio — Radio Despatch Service
651 Forest Rd — 869 George St
Bexley NSW — Sydney NSW 2000

For current projects and a more comprehensive list of pc board suppliers refer to the Shoparound page in this and previous issues. This list will be updated roughly every four to six months.

Magnifying glasses may be bought at many general hobby shops, Newsagents and some stationary suppliers. Squint a little – it helps !

Project Electronics

041 Continuity Tester . . . . . T,D,B
042 Soil Moisture Indicator . . . . . T,D,B
043 Heads or Tails Circuit (Oct 76) . . T,D,E,A,B,L
044 Two Tone Door Bell (Oct 76) . . T,D,E,O,A,B,L
045 500 Second Timer . . . . . T,D,O,A,B
047 Morse Practice Set . . . . . T,D,O,A,B
048 Buzz Board . . . . . T,D,A,B
061 Simple Amplifier (Oct 76) . . . . . T,D,O,A,B
062 Simple AM Tuner (Mar 77) . . . . . D,E,B
063 Electronic Bongos. . . . . D,A,B
064 Simple Intercom (Nov 76) . . . . . T,O,A,B
065 Electronic Siren . . . . . D,O,A
066 Temperature Alarm (Dec 76) . . . . T,D,E,A,B
067 Singing Moisture Meter. . . . . D,B
068 LED Dice Circuit (Oct 76). . . . . T,D,E,A,B
070 Electronic Tie Breaker (Jan 77)
071 Tape Noise Limiter (Jan 78). . . . . E,L
072 Two-Octave Organ (Jun 78) . . . . . D,B
081 Tachometer (Mar 77). . . . . T,E,O
082/
528 Intruder Alarm . . . . . T,E,A
083 Train Controller
084 Car Alarm . . . . . D,A,B
085 Over-rev Alarm
086 FM Antenna
087 Over-LED
088 Hi-Fi Speaker

Test Equipment

132 Experimenter's Power Supply (Feb 77) . . . .E
133 Phase Meter (Apr 77). . . . . .E
134 True RMS Voltmeter (Aug 77) . . . . . .E
135 Digital Panel Meter (Oct 77). . . . . .E
136 Linear Scale Capacitance Meter (Mar 78) . . .E
137 Audio Oscillator (May 78). . . . . .E
138 Audio Wattmeter (Nov 78)
139 SWR/Power Meter (May 78)
140 1 GHz Frequency Meter-timer (Mar 78) C
141 Logic Trigger (Jan 79)
142 High Current Power Supply (Feb 79). . . . . .E
143 Curve Tracer (Jan 79)
144 Expanded-scale RMS Voltmeter (Jun 79)
148 Logic Test Probe (Jul 79)

Simple Projects

243 Bip Beacon (Apr 77)
244 Alarm Alarm (Feb 77)
245 White Line Follower (Nov 77)
246 Rain Alarm (Apr 78) L
248 Simple 12V to 22V Converter (Jul 78)
249 Combination Lock (Apr 79). . . . . .E
253 'Hot Potato' Game (May 79)
254 Egg Timer (Jun 79)

Motorists' Projects

316 Transistor Assisted Ignition (May 77) . . D,O,E
317 Rev Monitor Counter (Jul 77). . . . . .E
319 Variwiper MK II (Sep 78) . . . . . .E
320 Battery Condition Indicator (Apr 79) . . . D,E

Audio Projects

448 Disco Mixer(Nov 76
449 Balanced Microphone Amp (Nov 76). . . J,E,L
450 Bucker Brigade Audio Delay Line (Dec 77)
451 Hum Filter (July 79) . . . . . .D
470 60 W Amp Module (May 79) . . . A,B,E,P,R,S
471 Stereo Preamp (June 79). . . . . A,B,E,P,R,S
473 Series 4000 Moving-coil Cartridge Preamplifier . . . . . .J
480 50-100 Watt Amp Modules (Dec 76) . . . . . J,E,D,O,R,A,,B,L
481 12 V 100 Watt Audio Amp (May 77). . . . . .E
481 High Power PA/ Guitar Amp (Jun 77) . . . . .O
482 Stereo Amp (Jan 77) . . . . . O,E
482 Stereo Amp Part 2 (Feb 77) . . . . . O,E
483 Sound Level Meter (Feb 78). . . . . .E
484 Simple Compressor Expander (Jul 77) . . . . .E
485 Graphic Equalizer (Jun 77) . . . . . .J,E
486 Gowl-round Stabilizer (Nov 77). . . . . .J
487 Audio Spectrum Analyser (Feb 78). . . . . .E
489 Audio Spectrum Analyser 2 (Apr 78) . . . .J,E
490 Audio Compressor (Dec 79)
491 Graphic Equaliser (Mar 79)
495 Transmission Line Speakers (Aug 77)

Miscellaneous

546 GSR Monitor (Mar 77). . . . . .E
547 Telephone Bell Extender (Jun 77) . . . . . .E
548 Photographic Strobe (May 77) . . . . . .E
549 Induction Balance Metal Detector (May 77). .E
550 Digital Dial (Aug 78 . . . . . .E
551 Light Chaser (Sep 78) . . . . . .E
552 LED Pendant (Sep 78)
553 Tape/Slide Synchroniser (Oct 78 . . . . . .E
556 Wind Speed/Direction Indicator (Dec 79)
557 Reaction Tester (Feb 79) . . . . . .E
558 Mast-head Strobe (Feb 79)
559 Cable Tester (Mar 79)
577 General Purpose Power Supply . . . . . .J
581 Dual Power Supply (Jan 77). . . . . .E
582 House Alarm (Jul 77). . . . . .T,O,E,A
House Alarm – Installation Instructions (Aug 77)
583 Marine Gas Alarm (Aug 77) . . . . . E,E
585 Ultrasonic Switch (Sep 77) . . . . . R,O,E,T,L
586 Shutter Speed Timer (Oct 77). . . . . .E
587 UFO Detector (May 78)
588 Theatrical Lighting Controller (Nov & Dec 77 Jan & Mar 78). . .N
589 Digital Temperature Meter (PCB135) (Dec 77) . . . . . .E
590 LCD Stopwatch (Oct 78) . . . . . .N
591 Up/Down Presettable Counter (Jul 78). . . . .E
592 Light Show Controller (Aug 78) . . . . . .E
593 Colour Sequencer (Dec 79)
594 Development Timer (Apr 79)
595 Aquarium Light Controller (May 79)

Electronic Music

602 Mini Organ (Aug 76) . . . . . .O,E,D,B
603 Sequencer (Aug 77)
604 Accentuated Beat Metronome (Sep 77) . . . .E
605 Temp Stabilized Log-exponential Converter (Sep 78)

Computer Projects

630 Hex Display (Dec 76). . . . . E,A
631 ASCII Keyboard (Dec 78) . . . . . .O,E,A
631 Keyboard Encoder (Apr 77). . . . . .O,E,A
632 Video Display Unit (Jan-Mar 77) . . . . . O,A
633 TV Sync Generator (Jan 77). . . . . E,A
634 8080 Educational/ Prototyping Interface (Jul, Aug 78)
635 Microcomputer Power Supply (Sep 77)
637 Cuts Cassette Interface (Jan 78). . . . .V,O,E,A
638 Eprom Programmer (Jul 78). . . . . E,A
639 Computerised Musical Doorbell (Mar 78) . . .A
640 S100 VDU (Apr, Jun 78) . . . . . .V,O,A
641 S100 Printer (Sep 78)
642 16k S100 RAM Card (Feb 79) . . . . . .K
650 STAC Timer (Nov 78)
651 Binary/hex Trainer (Jun 79)

Radio Projects

712 CB Power Supply (Jun 77). . . . . O,E
713 Add-on FM Tuner (Sep 77)
714 VHR-Log-Periodic Antenna (Feb, Mar 78)
715 VHF Power Amplifiers (Nov 77)
716 VHF Power Amplifiers (Jan, Feb 78)
717 Crosshatch Generator (May 78 . . . . . .E
718 SW Radio (Oct 78) . . . . . .E
719 RF Field Strength Indicator (Nov 78)
720 2 m VMOS Power Amp (Jan 79)
721 Aircraft Band Converter (Mar 79). . . . . D,E
722 Antenna for ETI-721 (May 79
724 Microwave Oven Leak Detector (Jul 79) . . . .D

Electronic Games

804 Selectagame (Nov 76 . . . . . .O
804 Selectagame (Rifle Project) (Mar 77). . . . .O
805 Puzzle of the Drunken Sailor (Oct 77)
806 Skeet (Jan 78)
810 Stunt Cycle TV Game (Jun 78) . . . . . O,D,B
811 TV Tank Game (Oct 78). . . . . .O,E,D,B
812 Wheel of Fortune (Dec 79)
813 Race Track Game (Jan 79)

NEW! 6809 EXORCISER COMPATIBLE MODULE

Designed and manufactured locally for Semcon

Features:

- MC6809 1 MHz CPU
- Fully buffered bus
- Two 6821 PIA's
- Two 6850 ACIA's with RS232 interface (One ACIA may be replaced with a 6852 S.S.D.A.)
- 4K static RAM accessible by external devices
- 4 sockets for up to 16K of EPROM (accepts 2708, 2716, 2516, 2532)
- O.S.9 in EPROM — this Unix based operating system written by Microware comes supplied with each module
- Programmable timer
- Supports D.M.A. channel
- Capable of tristating module bus buffers when external access is not required
- Break detect
- Power on reset
- 14411 baud rate generator

$950 plus tax
($799 if purchased without O.S.9)

SOFTWARE SUPPORT

The following software for the 6809 should be available early November

- Macroassembler
- Editor
- C-Compiler

Prices on application

7932A 32K STATIC RAM MODULE

- Now outline compatible with Motorola Exorciser cards
- Only available assembled and tested
- Includes 100 hour burn-in and 12 months warranty

Features: • Page mode operation — allows system expansion to 1 Megabyte • Quality PCB with solder resist • Motorola bus compatible • Low power — 2.5 amps typical • 300nS access • Fully static operation • Buffered address, data and control lines • Power rails in grid network for improved noise immunity • 4 x 8K blocks — Individually addressable, each write protectable, may be removed from address space if not required • Multi-phase operation — the module allows access during phase one and phase two — ideal for multiprocessing or DMA channels

32K	$650.00	16K	$430.00
24K	$540.00	8K	$320.00

Attention users of Motorola, Southwest Technical and Smoke Signal Hardware

Send large SAE with 50c stamp plus $2.00 for our latest catalogue. This includes detailed information on:

- Microware Software
- Microware SS50 Development System, including 2 MHz CPU and dual floppies.
- 6800 Macroassembler
- 6800 Assembler
- Sembug — Our new video orientated DeBug package.
- New 6809 Software.
- 6809 CPU Module.
- 32 K RAM Module.
- CRT02 Video Interface.
- 7908 EPROM Module.
- S-Bug Module.
- 10 Amp Switching P/s.
- 6802 CPU Module.
- ACIA Module.
- PIA Module.
- Timer Module.
- 32/32 I/O Module.
- Contact Closure Module.
- Wire wrap board.
- Extender card.
- A/D & D/A for SS50.

6800 SOFTWARE

FROM MICROWARE

SEMCON is now the Australian distributor of Microware Software.
It is available in the following formats:

- MIKBUG compatible cassette.
- SOUTH WEST TECHNICAL Diskette.
- SMOKE SIGNAL Diskette.
- MOTOROLA M-DOS.
- TEKTRONIX 8002.

(A) A/BASIC COMPILER — This is a true 6800 Basic Compiler that converts programs written in BASIC, into fast, efficient machine language programs. Its output runs without a run-time package and is directly ROMable according to user defined memory assignments. It requires 8K of RAM and permits the user to call up and incorporate his own machine language subroutines. **CASSETTE $85. SWT $175. SSB $175. M-DOS $500.**

(B) A/BASIC INTERPRETER — This is a source compatible, extremely fast, Basic Interpreter implemented as an incremental compiler. Its specially extended syntax and memory assignment features make it especially suited to process control and systems programming. It may also be used as an alternative to the text editor to prepare input for the Compiler. **CASSETTE $85. SWT $95. SSB $95. M-DOS $300.**

(C) A-BASIC SOURCE GENERATOR — This optional extra to the compiler disc versions, results in the production of a complete assembly listing from the object code produced by the compiler. **SWT $65. SSB $65. M-DOS $175.**

(D) CHESS PROGRAM — CASSETTE $65. SWT $65.

(E) LISP INTERPRETER — This list orientated language, featured in the August 1979 BYTE, is ideally suited to computer aided design, decisional logic and artificial intelligence. LISP programs have the capability of dynamically altering themselves making it an ideal language for programs that learn. **CASSETTE $90. SWT $95. M-DOS $275.**

(F) D2 UPGRADE KIT — This enables the D2 to communicate with an RS232 interface. **$45.**

(G) RT/68 — Supplied in a 2708 ROM, this monitor normally looks like MIKBUG to most progams. Its real power lies in its multitasking capabilities. When the system command is executed, it can supervise the execution of from one to sixteen tasks. Each task may be assigned a priority, time slice and state indicator. **$65.**

NEW! CRT02 VIDEO INTERFACE

Memory mapped with a difference!

Our versatile CRT01 video interface has been modified to enable simple installation in existing systems along with the addition of several new features:

- 2K page of on board RAM — the new module now looks like a 2K memory board, and plugs directly into any exorcisor bus.
- A 2716 is used as the character generator — up to **160** user defined characters may be programmed into the ROM — ideal for those languages requiring special symbols or in graphics applications.
- Dual Intensity (or optional flashing characters) for 96 of the 160 available characters. The inverse video is only available if programmed as special characters.
- Character font now 12 rows of 8 dots.
- Multiple CRT02's can be plugged into the bus.
- Retains all the versatility of display formats of the CRT01 as well as the logic to provide a stable flicker free display.

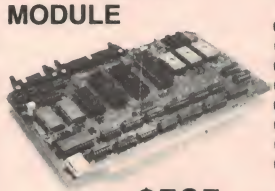
Price $350.

WIRE WRAP BOARD

- Double-sided ground & plus 5V
- plus/minus 12V on card
- Plated holes
- Gold edge connector

$47

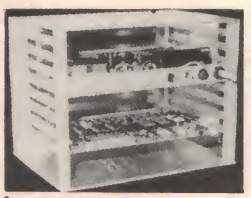
CMS 9600 MC6802 CPU MODULE



$565

- 6802 CPU
- 1.1K Static Ram with **battery back-up**
- 6K Eprom
- Programmable timer
- 2 PIA's
- 2 ACIA's — RS232
- Priority interrupt
- Address and data buffers
- Power failure protect/restart
- MC14411 Baud rate generator

(One ACIA may be replaced with SSDA)



SEMCON RACKING SYSTEM $153

($94 for rack without connectors)

• Sturdy aluminium construction • Blue anodised finish • Accommodates 8 Motorola Bus compatible cards • Tin plated backplane with ground plane on one side • 8 43x2x0.156" edge connectors.

SEMCON MICROCOMPUTERS PO Box 61, Pennant Hills, 2120. Tel (02) 848-0800

Add 15 percent tax where applicable. P&P: $2.50 Sydney Area. $3.50 elsewhere

Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here. Also, for a list of suppliers who stock the ETI projects published over the last 2½ years, our "Kits for Projects" page may generally be found on the page immediately before the DREGS page (inside the back cover), but this month it has been moved to page 77, two pages back.

The ETI 321 **Fuel Level Alarm** has been designed so it can either be mounted behind the dash with a remote alarm, or constructed in a small plastic box and then mounted in a convenient place under the dash or in a console. If you elect to use a box you will certainly want one that looks good and won't detract from the appearance of the car.

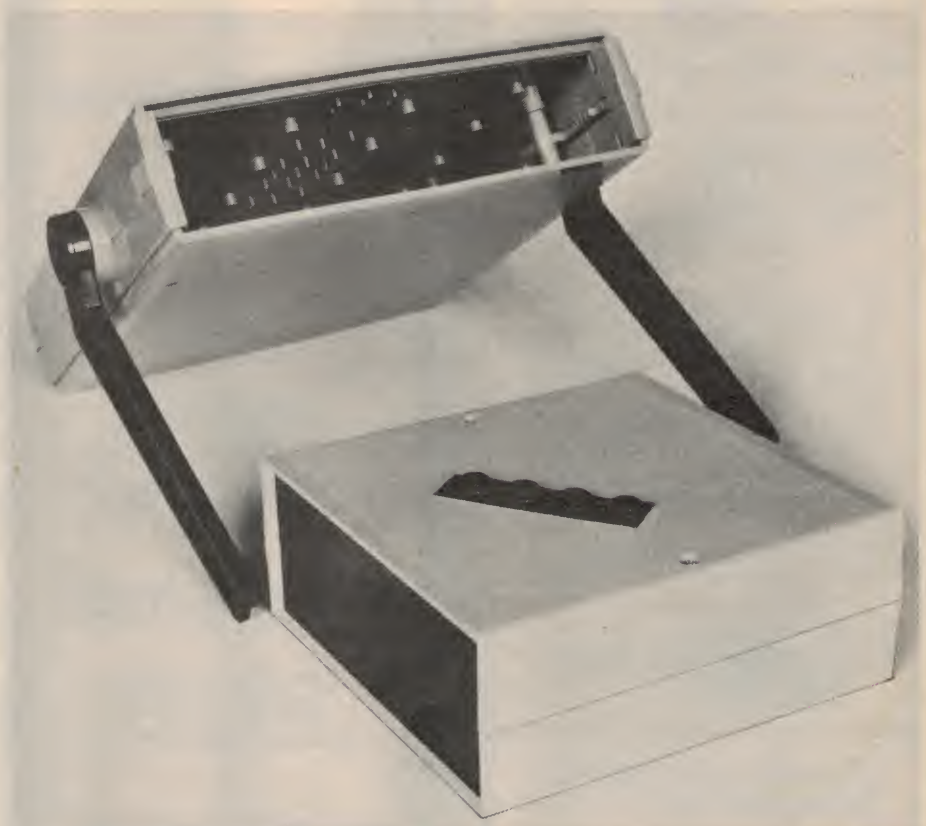
We used a PacTec box (CM5-125) distributed by Associated Controls and available from a number of suppliers. The boxes are available in black, tan, grey and blue and are made from impact resistant plastic, fitting neatly under the dash without detracting from the appearance of even the classiest car.

The PacTec range of boxes come in a large variety of shapes and sizes featuring pc board mounting fixtures, card slides, feet and handles. Expandable sides and interchangeable hardware allow the constructor to tailor the box to suit his requirements.

The PacTec box used in this project (CM5-125) and others in the range are available from most electronic suppliers, or from Associated Controls, 55 Fairford Rd, Padstow, NSW or 214-224 Wellington Rd, Mulgrave, Vic.

When we first considered using close tolerance resistors in the ranges of the **Linear Scale Ohmmeter** we thought that they were fairly rare beasts. It just shows how easy it is to get out of touch with what is available. We found it would be easier to mention the suppliers who didn't have them than those who indicated they did.

One supplier, Stewart Electronic Components, Mt Waverley, Vic, even stocks a complete range of ½% resistors for 30 cents each. Using 1% or 2% resistors in the project will give a full scale accuracy after calibration of about 2%, or that of the meter.



These beautifully-made 'PacTec' cases are made of moulded ABS plastic, come in a range of attractive colours and are available in 50 models. The two shown here should be popular with enthusiasts. The top one would suit many test instruments and features an integral handle and tilt-stand. The lower one assembles with just two screws, comes with a front and rear panel and stick-on feet. All models sport embossing in convenient places to allow mounting pc boards with PK screws. Available from Associated Controls P/L, 55 Fairford Rd, Padstow NSW 2211.

Protecting equipment, particularly expensive instruments or hi-fi equipment etc, from power line surges is a worthwhile investment. There are a number of techniques one can use but there is virtually nothing to beat **varistors.** These handy devices are a special type of resistor that will clip voltage surges to a safe value, protecting sensitive circuitry, preventing possible breakdowns.

All Electronic Components in Melbourne advise that they carry the **General Electric** range of varistors, currently stocking the 'ZA', 'LA' and 'PA' series of GE-MOV devices. They also stock copies of GE's excellent "Transient Voltage Suppression Manual" (2nd edition).

Sydney transformer manufacturer, Ferguson, are having a **clearout** this month **of some excess stock.** First on the list is the PL12/20VA/2 transformer (same construction as the rest of the PL/20VA series) which has a 240 V input and a single output winding that will deliver 12 V at 1.67 A. They're going for $3.83 each, complete with a set of leads, add postage (weight: 800 g). Second is a handy little "Plug Adaptor" type PPA9/500 which is constructed as per their Power Pack battery eliminator series only it has a 9 V ac output. It comes complete with output lead and 2.5 mm jack plug for a mere $2.88 plus postage (weight: 300 g) All prices include sales tax. They're at 331 High St, Chatswood, 2067.

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Z8000 TECHNICAL PROGRAM

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ETI-643 UNIVERSAL EPROM PROGRAMMER SOFTWARE LISTING

AS EXPLAINED in the text with the constructional article (last issue), the real power of the programmer lies in its control program. This listing is an assembly language listing with copious annotations. This is not the place to introduce readers to 8080 assembly language (there are several good texts available), but some comments are in order.

The bulk of the program outputs messages to the user, instructing him how to use the programmer, and examines his responses to select the correct routine to program, verify or erasure-test the correct EPROM type. In actual fact, the EPROM programming software itself is only a small part of the program, starting at label BT708.

The program was assembled using the Processor Technology PTDOS assembler, which has some slight differences from the Intel standard. For example, lines like: 'label' EQU $ merely assign the label to the address of the next instruction the assembler encounters. Lines starting with an asterisk are comments, and ignored by the assembler. The DW assembler directive merely stores the operand directly in memory at that address, with the two bytes reversed in 8080 format. The DB directive does the same thing for a single byte, and the ASC directive stores a text string in memory.

This listing contains read and burn routines for the 2708 only. The routines for other EPROMs (RT716, RS758, RS716, RS732, BT716, BS758, BS716, BS732, CT716, CS758, CS716 and CS732) have been omitted due to lack of space. Suitable programs may be developed to suit your own requirements or may be obtainable from Acoustic Electronic Developments. At present, entries of the above-mentioned other EPROMs in the jump tables simply return the user to the start.

The user should provide console input/output routines SINP and SOUT, which input a character to the accumulator and output the character in B, respectively.

```
                ********************************************************
                ** AED EPROM PROGRAMMER PROGRAM **************************
                ********************************************************
                *
                * WRITTEN BY: DENNIN RIEPON
                *
                * COMMENTS EDITED BY: WAYNE WILSON
                *
0100                    ORG     100H
    0100                XEQ     100H
0100 31 24 08           LXI     SP,STACK+APEND
                *
                * NOW FOR THE SQUATES
                *
    0100        STACK   EQU     100H            ;LENGTH OF STACK
                *
    1000        LOC0    EQU     1000H           ;START OF NPROM PROGRAMME AREA
    0050        PORTA   EQU     50H             ;PORT A OF 8255
    0051        PORTB   EQU     PORTA+1         ;PORT B OF 8255
    0052        PORTC   EQU     PORTB+1         ;PORT C OF 8255
    0053        CTRL    EQU     PORTC+1         ;CONTROL PORT OF 8255
    000D        CR      EQU     0DH             ;CARRIAGE RETURN
    000A        LF      EQU     0AH             ;LION FEEDIN' TIME
    0D0A        CRLF    EQU     0D0AH           ;CR FOLLOWED BY LF
    0005        NUMB    EQU     5D              ;MEMU NUMERICAL LIMIT
    BC80        PTDOS   EQU     0BC80H          ;OUR MONITOR RETURN POINT
    001E        ESC     EQU     1BH             ;THE CODE WE USE TO RET TO MONITOR
                *
                * IE THE BEGINNING THERE IS THE COMMAND MODULE
                *
    0103        START   EQU     $               ;ONLY TO CONFUSE THE ENEMINIES
0103 01 00 70           LXI     H,7000H         ;THIS INIT'S 8255
0106 3H 90              MVI     A,90H           ;SET MODE A=IN, H=OUT, C=OUT
0108 D3 53              OUT     CTRL            ;8255 NOW READY
010A CD 8B 03           CALL    PPIIE           ;THIS MAKES SOCKET SAFE AND LED OFF
010D 21 A3 03   SIGN    LXI     H,SIGON         ;LOAD MENU MESSAGE ADDRESS
0110 CD 08 03           CALL    WRITE           ;OUTPUT MENU TO CONSOLE
0113 21 FE 06           LXI     H,BUFF          ;WHERE IS THE INPUT CHAR BUFFER?
0116 06 02              MVI     B,2
0118 CD 14 07   L1      CALL    CONIN           ;GET CHAR FROM CONSOLE
011B FE 1B              CPI     ESC             ;IS IT TIME TO RETURN TO MOMMA
011D CA 74 01           JZ      RMON            ;THIS IS MOMMA
0120 77                 MOV     M,A             ;SAVE IT
0121 CD 01 07           CALL    CONOT           ;ECHO IT... . . . . . it!
0124 23                 INX     H
0125 05                 DCR     B
0126 C2 18 01           JNZ     L1              ;KEEP LOOPIN' TILL BOTH ARN IN
0129 2H                 DCX     H
012A 2B                 DCX     H               ;POINT BACK TO FIRST CHAR IN BUFF
012B 7H                 MOV     A,M             ;GET FIRST CHAR OUT OF BUFF
012C 23                 INX     H               ;POINT AT NEXT CHAR
012D 06 05              MVI     B,NUMB          ;SET LIMIT OF VALID NUMBERS
012F FE 52              CPI     'R'             ;IS IT TO EE A "READ"
0131 CA 44 01           JZ      P1              ;IF SO, THEN PROCESS FOR READ
0134 FE 42              CPI     'B'             ;IS IT TO BE A "BURN"
0136 CA 57 01           JZ      P2              ;IF SO, THEN PROCESS FOR BURN
0139 FH 43              CPI     'C'             ;IS IT TO BE A "COMPARN"
013B CA 5E 01           JZ      P3              ;IF SO, THEN PROCESS FOR COMPARN
013E 21 E7 04           LXI     H,ERRM1         ;POINT AT ALPHA ERROR MESSAGE
0141 C3 6E 01           JMP     P4              ;GO AND PRINT ERROR MESSAGE
                *
                * THIS IS THE "READ" PROCESSOR
                *
    0144        P1      EQU     $
0144 7E                 MOV     A,M             ;GET THE FROM TYPE NO. (7)
0145 21 7D 01           LXI     H,RTABL         ;LOAD START DF READ JUMP TAHLH
0148 D6 31      FNUMB   SUI     '1'             ;REMOVE ASCII OFFSET
014A CA 65 01   L2      JZ      JUMP            ;IF ACCUMULATOR IS 0 THEN JUMP
014D 23                 INX     H               ;NOT THE ONN YET!
014E 23                 INX     H               ;SO BUMP UP THE JUMP TABLE POINTER
014F 05                 DCR     B               ;END DF POSSIBLH VALID NO'S YET!
0150 CA 6A 01           JZ      FJMP            ;IF INVALID INPUT GOTO FJMP
0153 3D                 DCR     A               ;TRY EEXT ASCII NO.
0154 C3 4A 01           JMP     L2
                *
                * THIS IS THE "BURN" PROCESSOR
                *
    0157        P2      EQU     $
0157 7E                 MOV     A,M             ;GET FROM TYPE NO. (7)
0158 21 89 01           LXI     H,BTABL         ;POINT AT BURN JUMP TABLE
015E C3 48 01           JMP     FNUMB           ;GO TO ROUTINH WHICH FINDS
                                                ;AND JUMPS TO CORRECT MODULE
                *
                * THIS IS THE "COMPARE" PROCESSOR
                *
    015E        P3      EQU     $
015H 7E                 MOV     A,M             ;GET FROM TYPE NO. (7)
015F 21 95 01           LXI     H,CTABL         ;POINT AT COMPARN JMP TAHLE
0162 C3 48 01           JMP     FNUMH           ;DITTO AS IN P2
                *
                * BELIEVE IT OR NOT, THIS CAUSES A JUMP TO CORRECT MODULE
                *
    0165        JUMP    EQU     $
0165 5E                 MOV     E,M             ;PREPARN FOR A JUMP
0166 23                 INX     H
0167 66                 MOV     H,M
0168 6H                 MOV     L,E
0169 E9                 PCHL            ;GO JUMP (TO WHEREVER)?
                *
                * THIS REPLIES TO AN INCORRECT NO. ENTRY
                *
    016A        FJMP    EQU     $
016A 5E                 MOV     H,M             ;GET THE MESSAGH
016H 23                 INX     H
016C 66                 MOV     E,M
016D 6E                 MOV     L,E             ;NL NOW HAS MESSAGE ADDRESS
016E CD 78 03   P4      CALL    CRWAT           ;WAIT FOR A <CR>
0171 C3 0D 01           JMP     SIGH            ;AND TRY AGAIN
                *
                * RETURN TO MONITOR BUT FIRST TIDY UP THE MESS ON SCREEN
                *
    0174        RMON    EQU     $
0174 21 02 06           LXI     H,TWESS         ;CLEANUP MESSAGE
0177 CD 08 03           CALL    WRITE
017A C3 H0 BC           JMP     PTDOS
                *
                * THESH ARH THH TABLHS
                *
    017D        RTABL   EQU     $
017D A1 01              DW      RT708           ;READ TRIPLE SUPPLY 2708
017F F4 02              DW      RT716           ;READ TRIPLE SUPPLY 2716 ALIAS 2516
0181 F4 02              DW      RS758           ;READ SINGLE SUPPLY 2758
0183 F4 02              DW      RS716           ;READ SINGLE SUPPLY 2716
0185 F4 02              DW      RS732           ;READ SINGLE SUPPLY 2732
0187 D4 04              DW      ERRM0           ;ADDRESSB OF HRROR MESSAGE
                *
    0189        BTABL   EQU     $
0189 DD 01              DW      BT708           ;IF YOU CANT WORK OUT THE COMMENTS
018H F4 02              DW      BT716           ;THEN HOW THH HELL DID YOU GET
018D F4 02              DW      BS758           ;THIS FAR!
018F F4 02              DW      BS716
0191 F4 02              DW      BS732
0193 D4 04              DW      ERRM0
                *
    0195        CTABL   EQU     $
0195 AF 02              DW      CT708
0197 F4 02              DW      CT716
0199 F4 02              DW      CS758
019H F4 02              DW      CS716
019D F4 02              DW      CH732
019F D4 04              DW      ERRM0
                *
                * EERE IN THE 2708 READ ROUTINE
                *
    01A1        RT708   EQU     $
01A1 01 00 F0           LXI     H,0F000H
01A4 3E 90              MVI     A,90H           ;PROGRAM UP 8255 FOR READING
01A6 D3 53              OUT     CTRL            ;
01A8 CD 8B 03           CALL    PPIIE           ;TURN ON LED, MAKE SOCKET SAFE
01AB 21 24 06           LXI     H,SMES2         ;ERROR MESSAGE TO BE USED
01AE 22 AB 05           SHLD    POIN5           ;PLUG IT INTO PLACE
01B1 21 C7 06           LXI     E,READM         ;LOAD HL WITH COMMAND TYPE
01B4 11 EA 06           LXI     D,M2708         ;LOAD DE WITH TYPE NO. ADDR
01B7 CD 44 03           CALL    POKE            ;SET MESSAGE FOR TYPE AND JOH
01BA 01 FF 73           LXI     E,73FFH         ;POINT AT END OF EPROM
01BD 21 FF 13           LXI     H,LOC0+3FFH     ;POINTS AT END OF RAM AREA
01C0 CD 8B 03   REPOL   CALL    PPIIN           ;GET EYTE FROM EPROM
01C3 77                 MOV     M,A             ;STORE IT IN RAM
01C4 2E                 DCX     H               ;ON TO NEXT BYTH
01C5 0E                 DCX     E
01C6 7E                 MOV     A,E             ;IS IT THE END
01C7 F6 F0              DRI     0F0H            ;END OF NPROM
01C9 A1                 ANA     C               ;YES?
01CA 3C                 INR     A               ;(JUST TO GET IT BACK TO ZERO
                                                ;FOR THE TEST)
01CB C2 C0 01           JNZ     REPOL           ;IF NOT CONT "READ NPROM LOOP"
01CE 01 00 F0           LXI     E,0F000H        ;NOW MARK SOCKET SAFE AGAIN
01D1 CD 8H 03           CALL    PPIIN
01D4 21 12 05           LXI     H,RECOM         ;POINT AT READ COMPLETE MESS
01D7 CD 78 03           CALL    CRWAT           ;WRITE IT UP, AND WAIT FOR <CR>
01DA C3 03 01           JMP     START
                *
                * HERN IS THE 2708 EURN ROUTINE
                *
    01DD        BT708   EQU     $
01DD 01 00 F0           LXI     E,0F000H
01E0 3E 90              MVI     A,90H           ;READY 8255 FOR READ
01E2 D3 53              OUT     CTRL
01E4 CD 8B 03           CALL    PPIIN           ;MAKE SOCKET SAFE
01E7 21 3B 06           LXI     H,SMES3         ;ERROR MESSAGE TO BE USED HERE
01EA 22 05              SHLD    POIN5           ;PUT IT AT THIS POINT
01ED 21 D8 06           LXI     H,SURMM         ;POINT AT BURN COMMAND TYPE
01F0 11 EA 06           LXI     D,M2708         ;POINT AT DEVICE TYPE NO.
01F3 CD 44 03           CALL    POKH
01F6 21 03 01           LXI     H,START         ;THIS IS THE RETURN ADDR
                                                ;IN CASH THERE IS AN ERROR
01F9 E5                 PUSH    H               ;PUT IT ON STACK READY FOR A RET
01FA 01 00 74           LXI     E,07400H        ;POINT AT 1 PAST END OF EPROM
01FD 0E         BEVLP   DCX     B               ;DROP LOOP BY ONE
01FE 7E                 MOV     A,E             ;TEST FOR END OF VERIFICATION
01FF F6 F0              ORI     0F0H            ;OF ERASURE
0201 A1                 ANA     C
0202 3C                 INR     A               ;WILL IT BE THE END
0203 CA 14 02           JZ      BUCOM           ;IF YES, JUMP TO BURN COMMENCE
0206 CD 8B 03           CALL    PPIIN           ;IF NOT, GET THIS NYTE FROM EPROM
0209 FH 00              CPI     0FFH            ;IS BYTE ERASED
020H CA FD 01           JZ      BEVLP           ;IF YES, CONT BURN VERIFICATION LOOP
020E 21 99 05           LXI     H,ERROR         ;IF NOT, PT. AT ERROR MESS
0211 C3 78 03           JMP     CRWAT           ;PRINT AND WAIT FOR RESPONSH
                                                ; (RESPONSH RETURNS
                                                ;YOU TO START)
0214 21 C8 05   BUCOM   LXI     H,EURMM         ;POINT AT BURN MESSAGE
0217 CD 08 03           CALL    WRITH           ;WRITH IT UP
021A 01 00 60           LXI     B,06000H        ;PREPARE PROGRAMMER FOR
021D 3E 80              MVI     A,80H           ;PROGRAMMING MODE
021F 32 00 07           BTA     FLASH           ;STORE FLAG TO FLASH GREEN LED
0222 D3 53              OUT     CTRL            ;PROGRAMME 8255
0224 CD 8B 03           CALL    PPIIN           ;  NOW
0227 21 24 06           LXI     H,SMES2         ;THH ERROR MESSAGE TO HH USED
022A 22 AB 05           SHLD    POIN5           ;TO BE PUT HERH
022D 1E 64              MVI     E,100D          ;NO. OF LOOPS TO EE DONE
022F 21 FF 13   CNTLP   LXI     H,LOC0+3FFH     ;POINT AT APPR. POINTS IN RAM
0232 01 FF 63           LXI     E,63FFH         ;AND IN EPROM
0235 56                 MOV     D,M             ;GET A CHAR
0236 CD 99 03           CALL    PPIOT           ;OUTPUT IT TO PROGRAMMER
0239 3A 00 07           LDA     FLASH           ;SET LED APPR. WAY (ON OR OFF)
023C D5                 PUSH    D               ;SAVE DE
023D 57                 MOV     D,A             ;PUT FLASH TO ONN SIDE
023H 7H                 MOV     A,H
023F H6 0F              ANI     0FH             ;MASK OF DLD CTRL NYNBLH
0241 F6 40              ORI     40H             ;PUT IN EEN ONNE
0243 E2                 ORA     D               ;PUT IN LED CTRL
0244 47                 MOV     B,A             ;READY POR OUTPUTTING
0245 D1                 POP     D               ;GET DE BACK (IT'S NEEDED)
0246 CD 99 03           CALL    PPIOT           ;AND THEN OUTPUT IT
0249 3E 01              MVI     A,1             ;NUMBER DF 1 mS TIMNING LOOPS
024H CD F7 02           CALL    TIMER           ;TIME OUT
024E 3A 00 07           LDA     FLASH           ;SAME AS ABOVE EXCHPT
0251 D5                 PUNH    D
0252 57                 MOV     D,A             ;PUT FLASH TO ONE SIDE
0253 7E                 MOV     A,B
0254 H6 0F              ANI     0FH             ;MASK DFF CTRL NYESLE
0256 F6 60              DHI     60H             ;PROG. PULSE IS EHING TURNED OFF
0258 E2                 DRA     D               ;
0259 47                 MOV     E,A             ;
025A D1                 POP     D               ;
025H CD 99 03           CALL    PPIDT           ;NOW TURN IT OFF
025H 2B                 DCX     H               ;PREPARN FOR NEXT NYTE
025F 0E                 DCX     E
0260 7E                 MOV     A,E             ;GET UPPER ADDR & CONTROL
0261 F6 F0              DRI     0F0H            ;MASK OUT CONTROL NYNBLH
0263 A1                 ANA     C               ;AND IT WITH LOWER ADDR
0264 3C                 INR     A               ;ADD 1 TO "A"
0265 C2 35 02           JNZ     RLOOP           ;IF "A" NOT 0, THEN KEEP LOOPING
0268 3A 00 07           LDA     FLASH           ;COMPLIHENT THE LED FLASH FLAG
026B 2F                 CMA
026C H6 80              ANI     80H             ;
026H 32 00 07           STA     FLASH           ;AND PUT AWAY FOR SAFETY
0271 CA 79 02           JZ      PWR             ;IF "A" THEN MISS THE OUTPUT
0274 3E 23              MVI     A,'#'           ;PUT A LOOP MARKER TO SCREEN
0276 CD 01 07           CALL    CONOT           ;
0279 1D         PWR     DCR     E               ;DROP LOOP COUNT BY 1
027A C2 2F 02           JNZ     CNTLP           ; IS IT END DF LOOP
027D 06 70              MVI     E,70H           ;IF SO, MARH SOCKET SAFE
027F CD 99 03           CALL    PPIOT           ;
0282 01 FF 73           LXI     E,73FFH         ;AND PREPARE FOR A CHECK ON
0285 3H 90              MVI     A,90H           ;PROGRAMMED DATA
0287 D3 53              OUT     CTRL            ;
0289 21 FF 13           LXI     H,LOC0+3FFH     ;POINT AT RAM AREA
                *
028C CD 8H 03   BCOML   CALL    PPIIN           ;GET AH INPUT FROM PROGRAMMER
028F BE                 CMP     M               ;COMPARE WITH WHAT IS IN MEMORY
0290 CA A3 02           JNZ     COMER           ; IF IT DOESH'T, THEN WRITE ERROH MESS
0293 2H                 DCX     H               ;OTHERWISH LOOK AT NEXT NYTE
0294 0H                 DCX     B               ;
0295 78                 MOV     A,E             ;TEST FOR END DF ELOCK
0296 F6 F0              ORI     0F0H            ;
0298 A1                 ANA     C               ;
0299 3C                 INR     A               ;
029A C2 8C 02           JNZ     BCOML           ;IF NOT, KEEP LOOKING
029D 21 E1 05           LXI     H,BCOMM         ;POINT AT BONE COMPLETE MESS
02A0 C3 A6 02           JMP     PAST1           ;JUMP PAST THE ERROH MESS
02A3 21 99 05   COMER   LXI     H,HRROR         ;ADDR DF ERROR MESSAGH
02A6 01 00 F0   PAST1   LXI     B,0F000H        ;MARK SOCKET SAFH
02A9 CD 8B 03           CALL    PPIIN           ;  NOW
02AC C3 78 03           JMP     CRWAT           ;WRITE UP ANY MESSAGES
                *
                *HERH IS THH 2708 COMPANE ROUTINH
                *
    02AF        CT708   EQU     $
02AF 01 00 F0           LXI     E,0F000H        ;MAKE SURE SOCKET IS SAFE
02B2 3E 90              MVI     A,90H           ;
02B4 D3 53              OUT     CTRL            ;
02B6 CD 8B 03           CALL    PPIIN           ;
02B9 21 24 06           LXI     H,SMES2         ;ERROR MESSAGE TO HH USED
02BC 22 AB 05           SHLD    POIN5           ;PUT IT AT THIS POINT
02BF 21 H1 06           LXI     H,COMPH         ;POINT AT COMMAND TYPE
02C2 11 EA 06           LXI     D,M2708         ;POINT AT DEVICE TYPE NO.
02C5 CD 44 03           CALL    POKH            ;POKE ABOVE INFO INTO CORRECT PLACES
02C8 01 FF 73           LXI     E,73FFH         ;POINT AT EPROM
02CB 21 FF 13           LXI     H,LOC0+3FFH     ;AND RAM READY FOR COMPARISON
02CE CD 8H 03   CLOOP   CALL    PPIIN           ;GET INPUT FROM NPROM
02D1 BE                 CMP     M               ;COMPARE IT WITH NAM DATA
02D2 C2 H5 02           JNZ     COERR           ;IS IT IN ERROH
02D5 2H                 DCX     H               ;IF NOT, LOOK AT NEXT NYTES
02D6 0H                 DCX     B               ;
02D7 78                 MOV     A,B             ;TEST FOR END OF COMPARISON
02D8 F6 F0              DRI     0F0H            ;
02DA A1                 ANA     C               ;
02DB 3C                 INR     A               ;
02DC C2 CE 02           JNZ     CLOOP           ;IS IT END YET
02DF 21 EE 05           LXI     H,CCOMM         ;IF YES, POINT AT COMPARE COMPLETH
02E2 C3 E8 02           JMP     PAST2           ;JUMP PAST THE ERROH MESSAGE
02E5 21 99 05   COERR   LXI     H,ERROR         ;POINT AT THE ERROR MESSAGE
02E8 01 00 F0   PAST2   LXI     E,0F000H        ;AND MAKH SURE TBH SOKET IS SAFH
02EH CD 8B 03           CALL    PPIIN           ;
02EH CD 78 03           CALL    CRWAT           ;WRITE UP THE MESSAGE
02F1 C3 03 01           JMP     START           ;AND GO TO THE START OF THIS PROG
                *
    02F4        RT716   EQU     $
    02F4        RS758   EQU     $
    02F4        RS716   EQU     $
    02F4        RS732   EQU     $
    02F4        BT716   EQU     $
    02F4        BS758   EQU     $
    02F4        BS716   EQU     $
    02F4        BS732   EQU     $
    02F4        CT716   EQU     $
    02F4        CS758   EQU     $
    02F4        CS716   EQU     $
    02F4        CH732   EQU     $
02F4 C3 03 01           JMP     START
                *
                * THE TIMER
                *
    02F7        TIMER   EQU     $
02F7 C5                 PUSH    E
02F8 06 4A      OTMLP   MVI     E,74D
02FA 05         ITMLP   DCR     E
02FB 05                 DCR     B               ;TICKA, TICKA, TOCK
02FC 04                 INR     E
02FD C2 FA 02           JNZ     ITMLP
                        XTNL
0301 E3                 XTHL
0302 3D                 DCR     A
0303 C2 F8 02           JNZ     OTMLP
0306 C1                 POP     E
0307 C9                 RET
                *
                * THH MESSAGH WRITE ROUTINE
                *
                *       THIS WRITE SUBROUTINE IS A VERY SIMPLE MACRO PROCESSOR.
                *       IN OPERATIDN IT READS CHARACTERS FROM MEMORY POINTED TO
                *       EY THH H & L REGISTERS.
                *       THERE ARH FOUR SPECIAL CHARACTERS IT RESPONDS TO, THREE
                *       ARH:-
                *
                *               "$" - END OF MESSAGH TO BE WRITTEN TO SCREEN,
                *                     SO RETURN TO THH MAIN ROUTINE.
                *
                *               "%" - THE FOLLOWING DATA IS THH NUMBER OF TIMES
                *                     THAT THE CHARACTER FOLLOWING THE DATA
                *                     HAS TO BE REPEATED.
                *
                *               "(" - SAVE PRESENT POINTER, THEN GO AND WRITE OUT
                *                     MESSAGE POWTED TO BY ADDRESS FOLLOWING
                *                     (ANALOGOUS TO A "CALL" INSTRUCTIDN)
                *
                *               ")" - END OF "SUH-MESSAGE", REPLACE ORIGINAL
                *                     POINTER AND CONTINUN ON WITH MHSSAGE
                *                     (ANALOGOUS TO "RET" INSTRUCTION)
                *
    0308        WRITE   EQU     $
0308 7E                 MOV     A,M             ;GET CHAR TO OUTPUT
0309 FE 7D              CPI     '}'             ;IS IT END OF INSERT
030E C2 12 03           JNZ     CPO             ;IF NOT "}", DON'T RETURN ADDR
030E E1                 POP     H               ;GO EACK TO WHERH YOU LEFT OFF
030F C3 08 03           JMP     WRITE
0312 FE 24      CPO     CPI     '$'             ;IS IT END OF MNHSAGE
0314 C8                 RZ              ;IF YNS THEN RETURN TO SENDER
0315 FE 7B              CPI     '{'             ;IS THERN AN INSERT
0317 C2 22 03           JNZ     CHOUT           ;IF NOT, STRAIGHT TO CHAR OUTPUTTER
031A 23                 INX     H               ;GET ADDRNSS OF SUH-MNSSAGH
031B 5E                 MOV     E,M
031C 23                 INX     E
031D 56                 MOV     D,M
031E 23                 INX     H               ;NOW POINT AT NEXT CHAR ALONG
031F E5                 PUSH    H               ;SAVE ADDRESS OF MESSAGE
0320 EH                 XCHG            ;PUT SUH-MESSAGH ADDRESS IN HL
0321 7H                 MOV     A,M             ;GET FIRST CHAR FROM SUH-MESS
0322 06 01      CHOUT   MVI     B,1             ;IF NO REPEAT, E HOLDS REPEAT NO.
0324 FH 25              CPI     '%'             ;IS THERN A CHAR TO BE RNPEATED
0326 C2 2C 03           JNZ     L3              ;IF NOT SO PASS
0329 23                 INX     H               ;POINT AT NO. OF TIMES
032A 46                 MOV     B,M             ;HENOLD THE REPEAT NO.
032H 23                 INX     H               ;NOW POINT AT CHAR TO REPEAT
032C 7H         L3      MOV     A,M
032D C5                 PUSH    H               ;JUST IN CASE USER DON'T
032E F5         LPIND   PUSH    PSW             ;KEEP CHAR, IT'S TO HH USED AGAIH
                                                ;IN HIS OUTPUT ROUTINH
032F CD 01 07           CALL    CONOT
0332 F1                 POP     PSW             ;GET CHAR BACK OUT
0333 3D                 DCR     A               ;NOW, IF IT IS A CH, IT
0334 3D                 DCR     A               ;WILL BECOMN AN LF
0335 3D                 DCR     A               ;
0336 FE 0A              CPI     LF              ;AND IS TESTED
0338 CA 2H 03           JZ      LPIND           ;IF LF THEN GO BACK AND PRINT IT
033H C1                 POP     H               ;
033C 05                 DCR     B               ;HE THINKS THIS IS A LOOP COUNTER
033D C2 2C 03           JNZ     L3              ;HH THINKS I WAS RIGHT!
0340 23                 INX     H               ;
0341 C3 08 03           JMP     WRITE           ;
                *
                * EERE IS A POKE IN THE EYE FOR YOU
                *
    0344        POKE    EQU     $
0344 H5                 PUSH    H               ;HOLD COMMAND TYPE
```

```
0345 B5                 PUSH    B       ;TWICE!
0346 D5                 PUSH    D       ;THIS WILL BE USED AGAIN
0347 06 04              MVI     B,4D    ;TO KEEP COUNT OF WHERE WE ARE
0349 21 4C 05           LXI     H,POIN1 ;POINT AT FIRST POSITION
034C 1A         PKLP1   LDAX    D       ;GET CHAR
034D FE 7D              CPI     '}'     ;IS IT END OF STRING
034F CA 59 03           JZ      NPKE1   ;IF SO, POKE NEXT POINT
0352 77                 MOV     M,A     ;OTHERWISE CONTINUE
0353 13                 INX     D       ;POINT AT NEXT CHAR
0354 23                 INX     H
0355 0D                 DCR     C       ;LOWER FILL COUNT
0356 C3 4C 03           JMP     PKLP1   ;GO AROUND AND POKE NEXT POINT
0359 21 29 05   NPKE1   LXI     H,ONMES ;POINT AT START OF MESSAGE
035C 05                 DCR     B       ;DOWN THE COUNT
035D 78                 MOV     A,B     ;PUT COUNT WHERE IT IS USEFUL
035E CA 78 03           JZ      CRWAT   ;IF ALL AWAY, GO PRINT IT
0361 D1                 POP     D       ;GET BACK INFORMATION
0362 21 42 05           LXI     H,POIN3 ;POINT AT LAST POSITION
0365 FE 02              CPI     2       ;IS THE SECOND LAST 1
0367 CA 4C 03           JZ      PKLP1   ;IF YES, POKE AWAY
036A 21 9F 05           LXI     H,POIN4 ;NOW TRY NEXT POINT
036D FE 01              CPI     1
036F CA 4C 03           JZ      PKLP1   ;IF THIS 1 THEN JUMP
0372 59 05              LXI     H,POIN2 ;ELSE POINT AT 2ND POSITION
0375 C3 4C 03           JMP     PKLP1   ;NOW PUT TYPE NO. AWAY AGAIN
                *
                * THIS WAITS FOR A <CR>
                *
0378            CRWAT   EQU     $
0378 C5                 PUSH    B
0379 D5                 PUSH    D
037A CD 08 03           CALL    WRITE   ;OUTPUT MESSAGE TO CONSOLE
037D D1                 POP     D
037E C1                 POP     B
037F 21 F9 04           LXI     H,MESS2
0382 CD 14 07           CALL    CONIN   ;GET CHAR FROM CONSOLE
0385 FE 0D              CPI     CR
0387 C2 78 03           JNZ     CRWAT   ;IF WRONG RESPONSE, CHASTISE
038A C9                 RET
                *
                * PARALLEL PERIPHERAL INTERFACE INPUT (PPIIN) ROUTINE
                *
038B            PPIIR   EQU     $
038B 79                 MOV     A,C     ;PUT LOW ADDRESS BYTE IN A
038C D3 51              OUT     PORTB   ;OUTPUT ADDRESS BYTE TO PROGRAMMER
038E 79                 MOV     A,B     ;HIGH ADDRESS AND CONTROL NYBBLES
038F D3 52              OUT     PORTC   ;OUTPUT THEM TO PROGRAMMER
0391 3E 01              MVI     A,1     ;WAIT A LITTLE
0393 CD F7 02           CALL    TIMER
0396 DB 50              IN      PORTA   ;THEN GET DATA FROM PROGRAMMER
0398 C9                 RET             ;GO BACK TO THEM WHAT CALLED UB
                *
                * PARALLEL PERIPHERAL INTERFACE OUTPUT (PPIOT) ROUTINE
                *
0399            PPIOT   EQU     $
0399 79                 MOV     A,C     ;PUT LO ADDR BYTE IN "A"
039A D3 51              OUT     PORTB   ;OUTPUT ADDR BYTE TO PROGRAMMER
039C 7A                 MOV     A,D     ;NOW PUT DATA INTO "A"
039D D3 50              OUT     PORTA   ;OUTPUT DATA TO PROGRAMMER
039F 78                 MOV     A,B     ;NI ADDR & CONTROL NYBBLES IB "A"
03A0 D3 52              OUT     PORTC   ;OUTPUT THEM TO PROGRAMMER
03A2 C9                 RET             ;BACK TO BURNING CALLER
                *
                * THESE ARB THE CONSOLE MESSAGES
                *
03A3            SINON   EQU     $
03A3 25 09 0D 25        DB      '%',9,CR,'%',16D,' '
     10 20
03A9 41 43 4F 55        ASC     'ACOUSTIC ELECTRONIC DEVELOPMENTS'
     53 54 49 43
     20 45 4C 45
     43 54 52 4F
     4E 49 43 20
     44 45 56 45
     4C 4F 50 4D
     45 4E 54 53
03C9 0D 25 16 20        DB      CR,'%',22D,' ','['
     5B
03CE A3 06              DW      SWRD2
03D0 42 55 52 4E        ASC     'BURNER PROGRAM'
     45 52 20 50
     52 4F 47 52
     41 4D
03DE 0D 0D 25 10        DB      CR,CR,'%',16D,' '
     20
03E3 43 4F 4D 4D        ASC     'COMMAND FORMAT: <ALPHA><NUMBER>'
     41 4B 44 20
     46 4F 52 4D
     41 54 3A 20
     3C 41 4C 50
     48 41 3B 3C
     4E 55 4D 42
     45 52 3B
0402 0D 0D 25 0A        DB      CR,CR,'%',10D,' '
     20
0407 42 3D 42 55        ASC     'B=BURN'
     52 4E
040D 25 06 20           DB      '%',6D,' '
0410 7C 20 31 3D        ASC     '| 1=2708'
     32 37 30 38
0418 7B                 DB      '['
0419 6A 06              DW      SMES7
041B 7B                 DB      '['
041C 5A 06              DW      SMES5
041E 0D 25 16 20        DB      CR,'%',22D,' '
0422 7C 20 32 3D        ASC     '| 2=2716'
     32 37 31 36
042A 7B                 DB      '['
042B 6A 06              DW      SMES7
042D 7B                 DB      '['
042E 62 06              DW      SMES6
0430 0D 25 0A 20        DB      CR,'%',10D,' '
0434 52 3D 52 45        ASC     'R=READ'
     41 44
043A 25 06 20           DB      '%',6D,' '
043D 7C 20 33 3D        ASC     '| 3=2758'
     32 37 35 38
0445 7B                 DB      '['
0446 7A 06              DW      SMES8
0448 7B                 DB      '['
0449 5A 06              DW      SMES5
044B 0D 25 16 20        DB      CR,'%',22D,' '
044F 7C 20 34 3D        ASC     '| 4=2716'
     32 37 31 36
0457 7B                 DB      '['
0458 7A 06              DW      SMES8
045A 7B                 DB      '['
045B 62 06              DW      SMES6
045D 0D 25 0A 20        DB      CR,'%',10D,' '
0461 43 3D 43 4F        ASC     'C=COMPARE    | 5=2732'
     4D 50 41 52
     45 20 20 20
     7C 20 35 3D
     32 37 33 32
0475 7B                 DB      '['
0476 7A 06              DW      SMES8
0478 34 4B 20 42        ASC     '4K BYTE'
     59 54 45
047F 0D 0D 25 16        DB      CR,CR,'%',22D,' '
     20
0484 65 2E 67 2E        ASC     'e.g. B2=BURN A 2716'
     20 42 32 3D
     42 55 52 4E
     20 41 20 32
     37 31 36
0497 0D 0D 25 3F        DB      CR,CR,'%',63D,'-',CR,'%',16D,' '
     2D 0D 25 10
     20
04A0 54 59 50 45        ASC     'TYPE <ESC> TO RETURN TO MONITOR'
     20 3C 45 53
     43 3E 20 54
     4F 20 52 45
     54 55 52 4E
     20 54 4F 20
     4D 4F 4E 49
     54 4F 52
04BF 0D 25 18 20        DB      CR,'%',24D,' ','['
     7B
04C4 94 06              DW      SWRD0
04C6 20 52 45 51        ASC     ' REQUIREMENT S'
     55 49 52 45
     4D 45 4E 54
     20 24
                *
04D4            ERRM0   EQU     $
04D4 25 10 0D 25        DB      '%',16D,CR,'%',25D,' ','['
     19 20 7B
04DB C6 06              DW      SWRD6
04DD 4E 55 4D 42        ASC     'NUMBER'
     45 52
04E3 7B                 DB      '['
04E4 8A 06              DW      SMES9
04E6 24                 DB      '$'
                *
04E7            ERRM1   EQU     $
04E7 25 10 0D 25        DB      '%',16D,CR,'%',25D,' ','['
     19 20 7B
04EE C6 06              DW      SWRD6
04F0 41 4C 50 48        ASC     'ALPHA'
     41
04F5 7B                 DB      '['
04F6 8A 06              DW      SMES9
04F8 24                 DB      '$'
                *
04F9            MESS2   EQU     $
04F9 25 10 0D 25        DB      '%',16D,CR,'%',24D,' '
     18 20
```

```
04FF 3C 43 52 3E        ASC     '<CR> YOU DUMMY!'
     20 59 4F 55
     20 44 55 4D
     4D 59 21
0508 25 07 0D 24        DB      '%',7D,CR,'$'
                *
0512            RECOM   EQU     $
0512 25 10 0D 25        DB      '%',16D,CR,'%',25D,' '
     19 20
0518 52 45 41 44        ASC     'READ COMPLETE'
     20 43 4F 4D
     50 4C 45 54
     45
0525 7B                 DB      '['
0526 4F 06              DW      SMES4
0528 24                 DB      '$'
                *
0529            ONMES   EQU     $
0529 25 10 0D 25        DB      '%',16D,CR,'%',16D,' '
     10 20
052F 59 4F 55 20        ASC     'YOU HAVE SELECTED: '
     48 41 56 45
     20 53 45 4C
     45 43 54 45
     44 3A 20
0542            POIR3   DB      8D
054A 2D 20              DB      '-',' '
054C            POIR1   DB      4D
0550 0D 0D 25 15        DB      CR,CR,'%',21D,' ','['
     20 7B
0556 94 06              DW      SWRD0
0558 20                 DB      ' '
0559            POIR2   DB      4D
055D 20 4F 4B 20        ASC     ' ON SWITCH'
     53 57 49 54
     43 48
0567 0D 0D 25 0F        DB      CR,CR,'%',15D,' ','['
     20 7B
056D 9B 06              DW      SWRD1
056F 7B                 DB      '['
0570 A3 06              DW      SWRD2
0572 57 48 49 4C        ASC     'WHILE GREEN LIGHT IS ON'
     45 20 47 52
     45 45 4B 20
     4C 49 47 48
     54 20 49 53
     20 4F 4E
0589 25 07 0D 25        DB      '%',7D,CR,'%',19D,' ','['
     13 20 7B
0590 9B 06              DW      SWRD1
0592 7B                 DB      '['
0593 A3 06              DW      SWRD2
0595 7B                 DB      '['
0596 06 06              DW      SMES0
0598 24                 DB      '$'
                *
                *
0599            ERROR   EQU     $
0599 25 10 0D 25        DB      '%',16D,CR,'%',$D,' '
     08 20
059F            POIN4   DB      8D
05A7 7B                 DB      '['
05A8 B0 06              DW      SWRD4
05AA 7B                 DB      '['
05AB            POIN5   DB      2
05AD 7B                 DB      '['
05AE 4F 06              DW      SMES4
05B0 24                 DB      '$'
                *
05B1            BCOMM   EQU     $
05B1 25 10 0D 25        DB      '%',16D,CR,'%',26D,' '
     1A 20
05B7 42 55 52 4E        ASC     'BURN COMPLETE'
     20 43 4F 4D
     50 4C 45 54
     45
05C4 7B                 DB      '['
05C5 4F 06              DW      SMES4
05C7 24                 DB      '$'
                *
05C8            BURNM   EQU     $
05C8 25 10 0D 25        DB      '%',16D,CR,'%',19D,' ','['
     13 20 7B
05CF A3 06              DW      SWRD2
05D1 42 55 52 4E        ASC     'BURN NOW IN PROGRESS'
     20 4E 4F 57
     20 49 4B 20
     50 52 4F 47
     52 45 53 53
05E5 25 07 0D 25        DB      '%',7D,CR,'%',49D,' ','*',CR,'B'
     31 20 2A 0D
     24
                *
05EE            CCOMM   EQU     $
05EE 25 10 0D 25        DB      '%',16D,CR,'%',20D,' ','['
     14 20 7B
05F5 A3 06              DW      SWRD2
05F7 7B                 DB      '['
05F8 AA 06              DW      SWRD3
05FA 53 7B              ASC     'S['
05FC 17 06              DW      SMES1
05FE 7B                 DB      '['
05FF 4F 06              DW      SMES4
0601 24                 DB      '$'
                *
0602            TNESB   EQU     $
0602 25 18 0D 24        DB      '%',24D,CR,'$'
                *
0606            SMES0   EQU     $
0606 20 54 48 45        ASC     ' THEN HIT <CR>  ]'
     4E 20 48 49
     54 20 3C 43
     52 3E 20 20
     7D
                *
0617            SMES1   EQU     $                       AT
0617 20 57 49 54        ASC     ' WITH SOURCE]'
     48 20 53 4F
     55 52 43 45
     7D
                *
0624            SMES2   EQU     $
0624 20 7B              DB      ' ','['
0626 A3 06              DW      SWRD2
0628 44 4F 45 53        ASC     'DOES NOT ['
     20 4E 4F 54
     20 7B
0632 A3 06              DW      SWRD3
0634 7B                 DB      '['
0635 17 06              DW      SMES1
0637 7D                 DB      ']'
                *
0638            SMES3   EQU     $
0638 7B                 DB      '['
0639 A3 06              DW      SWRD2
063B 49 53 20 4B        ASC     'IS NOT FULLY ERASED]'
     4F 54 20 46
     55 4C 4C 59
     20 45 52 41
     53 45 44 7D
                *
064F            SMES4   EQU     $
064F 20 7B              DB      ' ','['
0651 B8 06              DW      SWRD5
0653 7B                 DB      '['
0654 A3 06              DW      SWRD2
0656 7B                 DB      '['
0657 06 06              DW      SMES0
0659 7D                 DB      ']'
                *
065A            SMES5   EQU     $
065A 31 4B 20 42        ASC     '1K BYTE]'
     59 54 45 7D
                *
0662            SMES6   EQU     $
0662 32 4B 20 42        ASC     '2K BYTE]'
     59 54 45 7D
                *
066A            SMES7   EQU     $
066A 20 54 52 49        ASC     ' TRIPLE SUPPLY ]'
     50 4C 45 20
     53 55 50 50
     4C 59 20 7D
                *
067A            SMES8   EQU     $
067A 20 53 49 4E        ASC     ' SINGLE SUPPLY ]'
     47 4C 45 20
     53 55 50 50
     4C 59 20 7D
                *
068A            SMES9   EQU     $
068A 25 07 0D 25        DB      '%',7D,CR,'%',28D,' ','['
     1C 20 7B
0691 0C 06              DW      SMES0+6
0693 7D                 DB      ']'
                *
0694            SWRD0   EQU     $
0694 53 45 4C 45        ASC     'SELECT'
     43 54 7D
                *
069B            SWRD1   EQU     $
069B 49 4E 53 45        ASC     'INSERT ]'
     52 54 20 7D
                *
06A3            SWRD2   EQU     $
06A3 45 50 52 4F        ASC     'EPROM ]'
     4D 20 7D
                *
06AA            SWRD3   EQU     $
06AA 41 47 52 45        ASC     'AGREE]'
     45 7D
                *
06B0            SWRD4   EQU     $
06B0 45 52 52 4F        ASC     'ERROR: ]'
     52 3A 20 7D
                *
06B8            SWRD5   EQU     $
06B8 25 07 0D 25        DB      '%',7D,CR,'%',19D,' '
     13 20
06BE 52 45 4D 4F        ASC     'REMOVE ]'
     56 45 20 7D
                *
06C6            SWRD6   EQU     $
06C6 49 4E 56 41        ASC     'INVALID ]'
     4C 49 44 20
     7D
                *
06CF            READM   EQU     $
06CF 52 45 41 44        ASC     'READ    ]'
     20 20 20 20
     7D
                *
06D8            BURNM   EQU     $
06D8 42 55 52 4E        ASC     'BURN    ]'
     20 20 20 20
     7D
                *
06E1            COMPM   EQU     $
06E1 43 4F 4D 50        ASC     'COMPARE ]'
     41 52 45 20
     7D
                *
06EA            M2708   EQU     $
06EA 32 37 30 38        ASC     '2708]'
     7D
                *
06F2            M2716   EQU     $
06F2 32 37 31 36        ASC     '2716]'
     7D
                *
06FB            R2758   EQU     $
06FB 32 37 35 38        ASC     '2758]'
     7D
                *
0704            R2732   EQU     $
0704 32 37 33 32        ASC     '2732]'
     7D
                *
                * HERE IS THE BUFFER
                *
070E            BUFF    DS      2
                *
0700            FLAGE   DS      1
                *
                * THIS IS THE CONSOLE OUTPUT ROUTINE
                *
0701            CONOT   EQU     $
                * YOU WILL HAVE TO REWRITE THIS ROUTINE TO SUIT YOUR
                * HARDWARE OR MONITOR. WE HAVE INCLUDED ONES AS AN EXAMPLE
                *
C019            SOUT    EQU     0C019H  ;OUR MONITORS OUTPUT ROUTINE
0701 F5                 PUSH    PSW
0702 C5                 PUSH    B
0703 D5                 PUSH    D
0704 E5                 PUSH    H
0705 47                 MOV     B,A
0706 CD 19 C0           CALL    SOUT
0709 E1                 POP     H
070A D1                 POP     D
070B C1                 POP     B
070C F1                 POP     PSW
070D 00                 NOP
070E 00                 NOP
070F 00                 NOP             ;WE EVEN GIVE YOU SPARE SPACE!
0710 00                 NOP
0711 00                 NOP
0712 00                 NOP
                *
                ********
                *
0713 C9                 RET
                *
                * THIS IS THE CONSOLE INPUT ROUTINE
                *
0714            COBIB   EQU     $
                *
                * YOU WILL ALSO HAVE TO WRITE OR PATCH YOUR OWN INPUT
                * ROUTINE TO SUIT YOUR SYSTEM (LUCK WASN'T MEANT TO BE EASY)
                *
C01F            SINP    EQU     0C01FH  ;OUR SYSTEM MONITOR INPUT
0714 CD 1F C0           CALL    SINP
0717 CA 14 07           JZ      COBIN
071A 00                 NOP
071B 00                 NOP
071C 00                 NOP
071D 00                 NOP
071E 00                 NOP
071F 00                 NOP
0720 00                 NOP
0721 00                 NOP
0722 00                 NOP
0723 00                 NOP
                *
                ********
                *
0724 C9         APEND   RET
                *
                * BERRIN LIETH THE END.
                *
```

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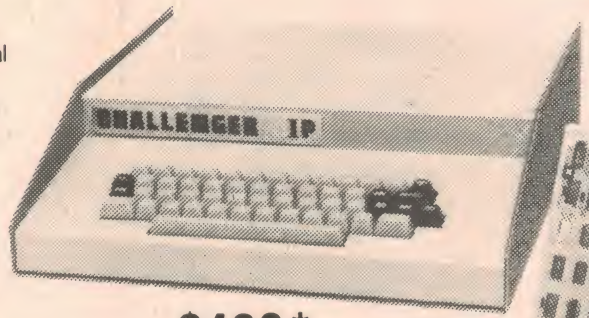

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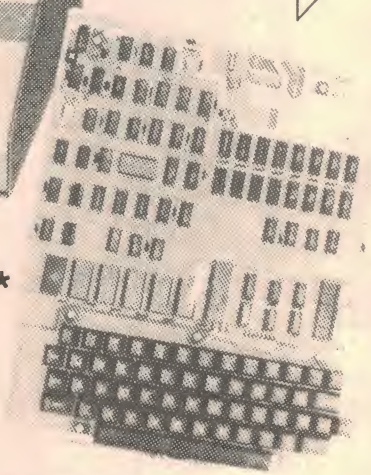

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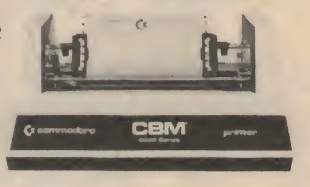

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"Home control" from home computers

Tandy's US retail chain, Radio Shack, will probably introduce a "home control" system this year, to interface with its TRS-80 home computer.

Some opposition companies — notably Apple and Commodore — indicated that, while ideas for such a system are intriguing, it will be two or three years before a suitable market exists for such a product.

Considering Tandy's huge success in marketing the TRS-80, it seems that they may be well placed to create the market awareness sufficient to launch such a product earlier than most predictions.

The US Radio Shack is already selling a stand-alone unit, the BSR/1X-10 Command Console, under the name "Plug-In Power". When connected to a timer, the console, which plugs into an ac outlet, can dim lights and turn appliances on and off.

Radio Shack executive vice-president John Roach, said "I think there is a reasonable chance we will interface it to the TRS-80 computer." Mr Roach said that if the firm were to make the move, it could be within "the next 9-12 months."

He said the product "would connect to the TRS-80 bus and be a black box, translating signals and information given out by the computer and put into a format where the BSR system can understand them."

Dennis Van Dusen, a consultant specialising in consumer data communications for Peat, Marwick, Mitchell & Co., said the market for what he called "a home control computer" is about 5 years away.

"There's no real market for it yet. Nothing in the home is that complex that it requires a home-control computer," he said.

The Ohio Scientific C8P DF is the closest to his concept, Mr Van Dusen explained. A true home-control computer would regulate stove temperature settings, shower temperatures, light switches, solar heaters, intercoms, doorbells, intrusion alarms and sensors, smoke detectors, furnaces, locks, stereos and other products, he said.

He described such a system as a "between the studs" computer — one which could not be moved.

Another development for controlling appliances is a home bus, operating over ac wiring. Such a system would not require a computer, but would "talk" over the ac wires.

Bob Richardson, director of the consumer electronics department at the Stanford Research Institute, said "Home bus is very similar to things a lot of factories are doing. It'll allow all types of consumer electrical devices to communicate with each other."

SRI and the Home Bus Association, both non-profit groups, are working on what they call a home bus standard.

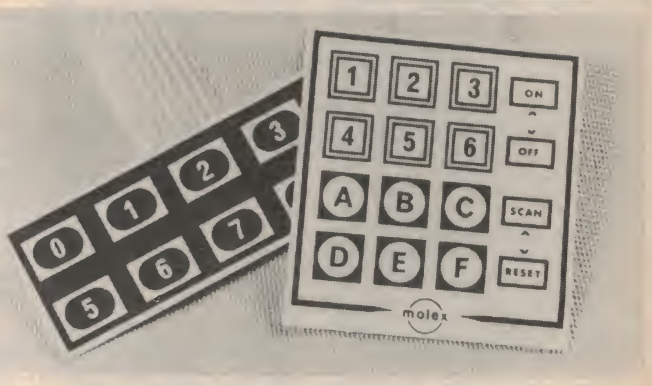
"A lot of equipment manufacturing companies are developing various approaches to remote control" of audio and other entertainment products, he said.

"You gain a lot of benefits if you develop a product that can communicate universally."

Mr Richardson said that equipment manufacturers, semiconductor to manufacturers and the IEEE had been working on the concept.

The concept involves the transmission of data through FM modulation over ac lines in the home. A decoder built into the appliance interprets the controls, "and each products lets the rest know what it's doing," Mr Richardson explained.

"If you had a home computer plugged into your ac system, you could control all the other devices with home bus decoders built into them. Your personal computer could be the major controller."



Molex membrane pads

Development of a special process to deposit conductive polymer ink on a flexible substrate has provided the technology required for a new switch product from Molex, the 10 900 Membrane Switch.

Construction consists of conductive silver contacts and interconnections deposited on two sections of a thin, flexible polyester sheet. A spacer layer with openings to create a contact gap is sandwiched between the two contact circuit halves and sealed. This produces a touch sensitive switch system that requires a minute force to actuate.

Upon actuation, the contact gap in the membrane section decreases until both silver contact surfaces meet and close the circuit. A custom graphic overlay may be secured to the top surface of the membrane switch.

The 10900 Membrane Switch is custom designed for each customer, meeting exact needs for switch contact spacing, aesthetics, mounting and termination. Termination to printed circuit boards and cable can be accomplished with standard Molex flat flexible circuitry connectors.

Typical industry applications include micro-processor systems, telecommunications, medical electronics, appliances, automotive, consumer electronics, electronic games, and more.

6809 Board

Semcon Microcomputers have announced a new board based on the Motorola MC6809.

We haven't spoken much about the 6809 on these pages, but basically it is an upgraded 6800 — upgraded beyong recognition, in fact. With an on-chip clock generator, hardware 8-bit multiplication, 16-bit addition and subtraction, two index registers and a wide variety of logical and consistent addressing modes for most instructions.

The 6809 is claimed to have anything up to three or four times the throughput of a Z-80 — oh well, them's the breaks!

There are also two 6821 PIAs on the board, giving 32 bits of parallel I/O, and two 6850 ACIAs providing RS-232C ports, although one of these may be replaced by a 6852 Serial Synchronous Data Adapter.

A 6840 Programmable Timer provides three channels, one of which may be used as a software controlled baud rate generator. Software support is in the form of the Microware OS9 Operating System — this Unix-like system forms the basis of a large amount of support software, including a macroassembler, editor, C complier and an integrated BASIC compiler/interpreter.

For further information contact Semcon at P.O. Box 61, Pennant Hills, NSW 2120. Tel: (02) 848-0800.

Printout

Rumours

Now that New South Wales Institute of Technology has got its radio broadcasting licence, a group of Sydney computer enthusiasts are said to be interested in conducting experiments in Digicasting, a scheme whereby digital data is sent over the air in an unused part of the radio signal. Technically, the scheme has similar potential to Teletext. Further details in this column if the experiments get off the ground . . .

Imsai, the well-known US manufacturer of 'mainframestyle' microcomputers (distinguished by the blue and red paddle switches) has finally liquidated. Although Imsai were reputed to be negotiating with the Belgian Government to build a factory there in return for injection of capital, this deal evidently did not come off. The liquidation sale did not raise enough cash to pay Imsai's debts, and the company's creditors are said to be investigating Imsai's tie-up with the Comperterland franchise operation. This won't make any difference to Computerland Australia's operations, however . . .

Meanwhile, Processor Technology, former manufacturers of the Sol computer, are still in business, several months after announcing that they would voluntarily liquidate. The company's assets and equipment have been sold off, and they're not manufacturing anything, so one wonders what they're doing . . .

Two suppliers have won contracts from the NSW Education Department for microcomputers to go into the State's schools. Computerland Australia will supply the Apple II computer which has had enormous success in the US education market due to its compactness, software support, excellent documentation and superb colour (or should that be color?) graphics. B & S Micro Applications Pty Ltd will offer their MAP2S system, which was unveiled at the Sydney Home Computer Show. This 2650-based computer will be backed with a disk system which can support several computers at the same time, sharing an expensive resource . . .

As part of the 8th World Computer Exhibition to be held in Melbourne on October 14th to 18th this year, there will be a Personal Computing Fair in the Great Hall of the Exhibition Building. The exhibition, which will be staged in conjunction with the 8th World Computer Congress under the auspices of the International Federation for Information Processing, has proved so popular that the organisers, Riddell Exhibition Promotions Pty Ltd, have decided to employ a new extension to the Eastern Stadium . . .

Incidentally, the membership of IFIP has recently been increased to 39 with the election of two new member countries; Morocco and the People's Republic of China . . .

Plessey have often taken note of the personal computing market, and their latest move puts them right into the market. They are offering (in Britain only at the moment, though it could happen here) 32 Kbyte memory addons for the Commodore PET. The Petite is a box containing 32 Kbytes of RAM and its own power supply which plugs into and sits beside the PET, while the Inpet is installed inside the computer, on the processor board . . .

In order to back up the new Winchester technology disk packs which are appearing these days, the 3M company has developed a tape cartridge with a 75 Mbyte capacity. The cartridge uses 26 tracks in conjunction with an MFM encoding technique similar to that used in floppy disks to obtain high data transfer rates and density . . .

Two new operating systems are available from Digital Research, the originators of CP/M. An enhanced version of CP/M called CP/M 2.0, will operate with minifloppies up to hard disks through an expanded file system. Configuration is accomplished through a definition table.

MP/M is a multiterminal operating system which supports real-time multiprogramming with foreground and background modes. The system can be easily configured through an interactive system generation utility. Currently available for the 8080/Z-80, MP/M will soon be available for the 8086.

The single-copy price for CP/M 2.0 is US $150 and for MP/M is US $300. Check with your local computer store for further details.

Heath have introduced two new computer products; the WH19 video terminal incorporates a Z-80 microprocessor, and looks rather like a DEC VT-52 terminal, as far as features are concerned. However, with the addition of a processor card and 5¼" (133 mm) floppy disk with Microsoft BASIC, the WH19 becomes the WH-89 computer. Both these machines are clearly slanted at the small business market, and Heath is promoting the machines heavily in the professional DP press . . .

commodore

the PET computer

The Pet has a television screen, a keyboard as simple to use as a typewriter and a self-contained cassette recorder which is the source for programmes and for storing data in connection with these programmes. And it has, in its standard configuration, an 8K user memory. (This is in addition to the 14K operating system resident in the computer).

SPECIAL AT NO EXTRA COST

$200 value of programmes will be provided with each PET purchased prior to December, 31st, 1979.

2001-16/32

The CBM Computer is now a truly sophisticated Business System with the announcement of these Peripherals.

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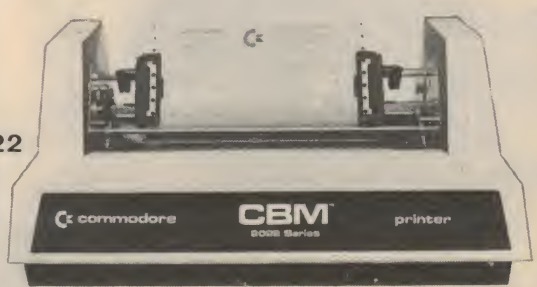
2040

Dual Drive Floppy Disk

The Dual Drive Floppy is the latest in Disk technology with extremely large storage capability and excellent file management. As the Commodore disk is an "intelligent" peripheral, it uses none of the RAM (user) memory of the CBM The Floppy Disk operating system used with the CBM computer enables a programme to read or write data in the background while simultaneously transferring data over the IEEE to the CBM The Floppy Disk is a reliable low cost unit, and is convenient for high speed data transfer. Due to the latest technological advances incorporated in this disk, a total of 340K bytes are available in the two standard 5¼" disks, without the problems of double tracking or double density. This is achieved by the use of two microprocessors and memory I.C.s built into the disk unit. Only two connections are necessary — an A/C cord and CBM interface cord.

Tractor Feed Printer

2022



The Tractor Feed Printer is a high specification printer that can print onto paper (multiple copies) all the CBM characters — letters (upper and lower case), numbers and graphics available in the CBM The tractor feed capability has the advantage of accepting mailing labels, using standard preprinted forms (customized), cheque printing for salaries, payables, etc. Again, the only connections required are an A/C cord and CBM connecting cord. The CBM is programmable, allowing the printer to format print for: width, decimal position, leading and trailing zero's, left margin justified, lines per page, etc. It accepts 8½" paper giving up to four copies. Bidirectional printing enables increased speed of printing.

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COMMUNICATIONS

March launch for Phase III-A OSCAR

AMSAT Phase III-A is a high altitude, long lifetime satellite to be launched in March 1980 as a secondary payload aboard an Ariane mission.

The European Space Agency will provide the launch opportunity from a site in Kourou, near the coast of French Guiana. The satellite will be inserted into an initial (temporary) elliptical orbit with a projected inclination of 17 degrees, an apogee of 35 000 km and perigee of 200 km.

After a few weeks in this orbit when the spacecraft has stabilized and the onboard microcomputer has determined that the satellite is in the proper orientation to the sun, to the earth, and at the proper position in its orbit, a one-shot onboard perigee kick motor will fire (a solid propellant motor that will burn for one 20-second period).

This will lift the perigee to its projected final 1500 km altitude and raise the inclination to 57 degrees.

This orbit will have a period of approximately 660 minutes and a longitude increment of about 165 degrees west per orbit. Please note that these figures are only preliminary estimates; the final data cannot, of course, be known until precise measurements are made after launch. These figures, however, are suitable for giving the potential satellite user a sense of what the orbit will be like.

This orbit will favour the Northern Hemisphere at first, as the apogee after the perigee kick motor firing will occur at about 26 degrees N latitude.

Over the course of the first two years, the latitude of the apogee will drift gradually northward to its highest point, 57 degrees N latitude. From this time on the apogee will drift southward until after another year or so it will occur over the equator. From this point on, the Southern Hemisphere will be favoured and the second of the AMSAT Phase III missions will have been launched, again initially favouring the Northern Hemisphere.

Throughout its lifetime, however, the AMSAT Phase III series satellites will be accessible throughout the world at some point during the day; those regions falling under the illumination at apogee will simply have greater access times.

AMSAT Phase III-A will carry a Mode B transponder. Its uplink will be in the 70 cm band and downlink in the 2 m band. The passband will accommodate SSB, CW, SSTV, RTTY, and whatever digital modes are approved for use through the satellite.

There will be several Special Service Channels that will deal exclusively with such areas as data exchange, education, scientific study, officially authorised traffic, and general interest/information bulletins from throughout the world.

A general beacon for routine telemetry and Codestore information, and an engineering beacon for more sophisticated management purposes will be at the very edges of the passband. To access the satellite, a user will need 1000 watts ERP on 70 cm — but high gain antennas to achieve this effective radiated power economically are feasible as near apogee (plus or minus three hours) AMSAT Phase III-A will move very slowly and through a comparatively small arc; tracking will be a fairly simple task.

(From Steve Place WB1EYI, AMSAT Phase III-A Education Special Service Channel Co-ordinator).

Late news

Beacons for Phase III spacecraft have been established: General Beacon 145.810 MHz. Engineering Beacon 145.990 MHz.

AMSAT advises that the Phase III Flight Ready Spacecraft has to be at the launch facility by 3rd December, 1979, and launch is still scheduled for 5th March, 1980. Checkout of the Flight Computer is being accomplished and everything thus far looks like a goer.

The Flight Transponder is coming along well and should meet schedule requirements. As of now 4077 solar cells are in hand and 39 battery cells. Preliminary indications show we should have a very good positive power budget for the Phase III spacecraft.

New 2m all-mode transceiver

Icom have released their new 2m all-mode Amateur Radio transceiver, the IC251A, replacing the popular IC211.

The new transceiver is controlled by a microprocessor and features scan, dual VFO, all modes and continuous tuning facilities.

Icom boast that the IC251A is the lightest all-mode transceiver, mainly due to the use of a pulse power supply.

The IC251A tuning system uses a photo-chopper system, as in the IC701 etc, which eliminates the need for variable capacitors and dial gear and therefore backlash.

Prices and additional details can be obtained from the Australian distributors, Vicom International Pty. Limited (phone Melbourne 699-6700, Sydney 436-2766) or their accredited dealers throughout Australia.

Clubs

The Southern Peninsula Amateur Radio Club (SPARC . . .!) meets at the Rosebud (Vic.) Primary School on the first and third Mondays of each month. They operate a net each Sunday on 28 350 kHz at 0000 Z. Club callsigns are VK3BSP and VK3VKR.

Prospective members can contact the Secretary, SPARC, Bob Whitehead VK3NHA, at 7 Spensley St, Rosebud 3939.

The Shepparton and District Amateur Radio Club meets at the Mechanics Institute Hall, 225 Wyndham St, Shepparton (Vic) on the first Wednesday of each month at 7.30 pm (local time) sharp. They also hold informal meetings on the third Wednesday of each month at the same venue.

Further information is available from the Secretary, S & DARC, P.O. Box 692, Shepparton 3630.

In the Newcastle (NSW) area, the **Jesmond and Districts Electronics and Communications Club** has been organised for local residents interested in electronics and amateur radio. The club organises lectures and practical workshops and licensed members may use the Club's amateur station VK2BHZ.

Ten members, under the guidance of Mr Leo McKenzie, recently achieved very successful results in the Youth Radio Service external examinations, obtaining eight honours and two credits.

The Club provides test equipment and a good range of tools. A new work bench has greatly increased the practical working area.

Interested persons are invited to inspect the Club facilities on Saturday afternoons between 1 pm and 5 pm in the rear of the Regal Theatre at Moore St, Birmingham Gardens, Newcastle, NSW.

COMMUNICATIONS

Solving the quad-builder's quandary

Sydney foundary, Ashpoint Pty Ltd, well-known in amateur circles for their "Bandit" universal cubical quad 'spider', have recently produced a set of 'standard' quad hubs for the enthusiast of these antennas.

Quads are renowned for their good gain and performance and are a popular antenna. These 'bandit' hubs from Ashpoint greatly simplify the usually mechanically tricky construction of quads.

As with the earlier spider hub, these latest hubs are made from "corrosion resistant" grade aluminium and are a single casting. 75 mm diameter wooden dowels or fibreglass blanks will fit into the grooved arms, held in place by ordinary hose clamps — available from your local hardware store.

The hubs come in three sizes, to fit 40 mm, 45 mm or 50 mm diameter booms. Cost is $16 each.

An article on construction techniques for quad antennas appeared in the August 1979 issue of ETI, page 33.

Hubs and further information are available from Mike Rychter, VK2NOW, at Ashpoint Pty Ltd, 43 Moxon Rd, Punchbowl NSW 2196.

ICOM power supply

Icom have released a new power supply for use with their high power IC551D 6 m transceiver and other matching transceivers.

The IC-PS20 is a fully regulated supply which eliminates the need for heavy power transformers as it employs a switch-mode technique.

The regulator switches at about 50 kHz. The output is rectified and filtered to produce 13.8 Vdc at a maximum load current of 20 amps. Short circuit protection is provided, as well as automatic shut off when the current exceeds 25 amps.

The unit weighs 4.2 kg (4 kg less than the earlier type), and is available with an optional fan for continuous operation on RTTY. Price of the IC-PS20 is $230. See Vicom, 68 Eastern Rd, South Melbourne, Vic 3205, (03) 699-6700.

Japanese CB exports dropped 78% in 1979

Exports to the US of Japanese CB transceivers with final output greater than 100 mW totalled only 40 155 units, valued at US$1 704 000, to the end of August last year.

This is a drop of 78% in quantity and 82% in value from the 182 212 units, US $9 264 000 worth, for the previous financial year.

The boom has definitely bust.

Channel 0 Wagga heard in Vienna

Walter Ertelt, OE1WEB, has confirmed with the ABC Engineering Department, that he received Channel 0 Wagga at his location in Vienna on 25th October last year, some 16 000 km distant!

Between 0820 and 0835 GMT that day, Mr Ertelt received both vision and sound signals (on 46.25 and 51.75 MHz), vision signal only up to 0900 GMT. He made a recording of the sound signal on a cassette and sent a copy to the ABC in Sydney.

Estimated signal strength was 20 — 30 dB above one microvolt and the signal exhibited long fading periods of 20 seconds. His antenna was a vertical dipole.

The transmission was most likely received via extended Class 1 (afternoon-type) trans-equatorial propagation (TEP), brought about by the current high solar activity (See ETI, June 1973, p. 88).

ETI received a copy of Mr Ertelt's letter from D.R. MacKay, VK2ZMZ, from the ABC Federal Engineering Department.

Scanner listener acquitted

In the Melbourne Magistrates' Court on 2 May 1979, Mr Walker, S.M., dismissed two charges against a Melbourne man brought under the Wireless Telegraphy Act.

The charges related to the use by the defendant of a Bearcat 210 scanning receiver. It was alleged by the informant, an officer of the Postal and Telecommunications Department, that the receiver was used in contravention of the Wireless Telegraphy Act. The Bearcat 210 receiver covers the frequency bands 32-50 MHz, 146-148 MHz, 148-174 MHz, 450-470 MHz, 470-512 MHz and 416-450 MHz.

Evidence was given that the defendant had admitted to receiving amateur, CB, marine and police transmissions. Evidence was also given that the receiver was capable of receiving the Wireless Institute's Sunday morning broadcast. The defendant gave evidence that it was his belief that he did not require a special licence to use the receiver.

In dismissing the charges, Mr Walker stated that he accepted the submission of Counsel for the defendant that the Bearcat 210 receiver was a receiver capable of receiving broadcasting programmes and by virtue of Section 130 (2) of the Broadcasting and Television Act a licence was not required for this receiver under the Wireless Telegraphy Act. The Magistrate also found that, in any event, the defendant had an honest and reasonable belief that the receiver in question was capable of receiving broadcast programmes, ruling in effect that he would have dismissed the charges on this ground alone. (Item courtesy 'Amateur Radio').

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AF300 AUDIO AMPLIFIER
A real work-horse, this universal power amp has a wide range of applications such as car radio, record players and small receivers.
Due to its well designed electronic circuit, the AF300 can be used over wide voltage ranges without deterioration of the specification parameters.
Kit AF300 — $25.00
AF340 40 WATT AUDIO AMPLIFIER MODULE
High quality 20-20,000 Hz, 37w RMS with low distortion.
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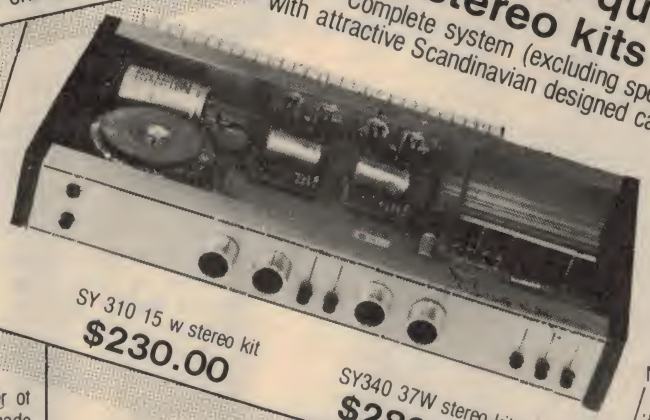
Stereo decoder HF 310
HF310 FM RECEIVER
The HF310 is a very reasonable priced HF FM tuner. Fully trimmed, the sensitivity according to IHF standards is better than 10uV. Features 60 dB S/N radio and low harmonic distortion.
Kit HF310 — $49.00
HF330 STEREO DECODER
Gives 40-45 dB channel separation, just add to a good quality FM receiver. Kit HF330 — $24.00

Pre-amps (RF)

HF395 RF PREAMPLIFIER
Gain 30dB to 20 MHz, 10 dB to 100 MHz and 5 dB to 226 MHz. Ideal to boost reception on short-wave receivers. Kit HF 395 — $6.00
HF385 VHF/UHF ANTENNA PREAMP
Superb quality with two acrial inputs and one down lead which simultaneously supplies current from the power supply. Frequency range 40-250 MHz and 400-820 MHz. Gain 9-18 dB, depending on frequency. Kit 385 — $30.00. Box B850 — $6.00.

New quality stereo kits

Complete system (excluding speakers) with attractive Scandinavian designed cabinet



SY 310 15 w stereo kit **$230.00**

SY340 37W stereo kit **$289.00**

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Turn your music into light. Simply connect this 3 channel light show to the audio terminals of your amplifier and this quality kit does the rest for you!
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This superb kit drives 4 lights (400w per channel) from the audio amplifier output. Kit AT468 — $75.00. Attractive box and knobs B3265 — $48.00
AT365 LIGHT SHOW
This quality kit uses microphone input instead of connection to the audio output. 1599w max.
Kit AT365 — $69.00
Box and knobs B3265 — $48.00

FM Transmitter

HF65 FM TRANSMITTER 60-148 MHz
Will run 5w output with heat sink. Ideal for signal testing of for a miniature transmitter which could be received on a standard FM receiver. Kit HF65 — $9.00.

Receiver Converter

HF305 VHF CONVERTER
Converts FM 105-148 MHz to 105 MHz.
Kit HF305 — $28.00
Box B3405 attractive chassis kit — $24.00

AM Receiver

HF61 MEDIUM WAVE RECEIVER 540-1600 KHz receiver complete with ferrite coil antenna. Kit HF61 — $9.00

Power Supplies

NT415 LAB POWER SUPPLY
0-30V 1 amp well-regulated supply for professional use. Complete with box and transformer.
Kit NT415 — $128.00
NT300 LABORATORY POWER SUPPLY
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Quick assembly kits

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JK04	FM TUNER 88-108 MHz	$30.00
JK05	27 MHz RECEIVER	$33.00
JK06	27 MHz TRANSMITTER	$29.00
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JK10	PHOTOGRAPHIC TIMER 240 Vac	$23.00
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New Kits

AT347	Electronic Roulette	$54.00
AT350	2 amp triac light controller	$12.00
AT357	Touch-control light dimmer	$33.00
AT356	6 amp AC regulator	$27.00
MI-360	Multivibrator, sq. wave to 10MHz	$6.00
SY-310	15w stereo amplifier kit	$230.00
SY-340	37W stereo amplifier kit	$289.00

VICOM

Mail Orders: Direct to VICOM, 68 Eastern Rd., Sth. Melbourne, Vic. 3205. **Enclose $1 extra** for handling and postage costs.

JostyKits are available now from:

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Radio Despatch Service
869 George St
Sydney Ph. 211 0816

Vicom International Pty Limited
339 Pacific Hwy.,
Crows Nest
(02) 436 2766

Adelaide: Hamtronics, Goodwood Rd, Kingspark, Ph. 272-8417. Port Adelaide.

International Communications Systems, 75-77 Dale St., Port Adelaide. Ph: 47-3688.

Melbourne: Eastern Communications, 898 Riversdale Rd Camberwell. Ph. 836 8635.

Tasman Electronics, 12 Victoria St, Coburg. Ph. 354 5062.

J.H. Magraths & Co. P/L., 208 Little Lonsdale St. Ph. 663 3736.

Brisbane: Delsound, 1 Wickham Tce. Ph. 229 6155.

Launceston: Advanced Electronics, 5A Quadrant, Ph. 31 7075. Tasmanian Hi-Fi Company, 87A Brisbane St. Ph. 31 5815.

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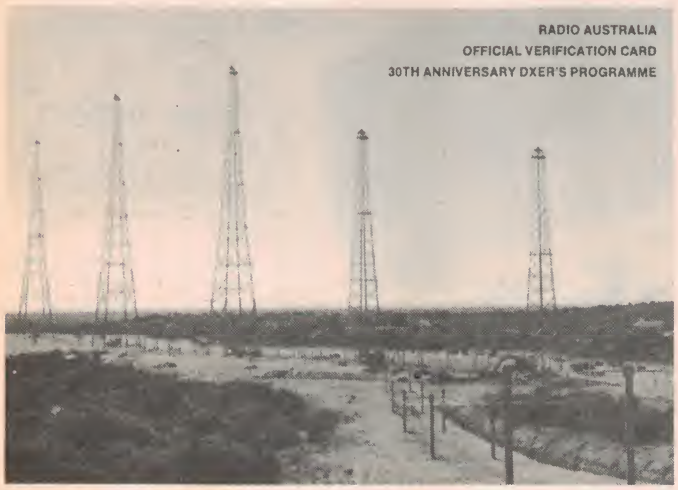
DX on the air — keep in touch with the latest tips

One of the best ways of keeping in tune with the latest happenings on the shortwave broadcasting bands is to listen in regularly to some of the DX programmes run by international broadcast stations.



These programmes are usually aired by major broadcasters with generally one edition every week, often with repeats at later times so that DXers around the world can listen into the programme at a convenient time, this usually being early morning or during evening hours.

The better programmes for DXers are usually run by radio station personnel with some knowledge of DXing, featuring loggings of new frequencies, new stations, plus technical tips and reviews of latest shortwave equipment.

Here are details of how you can hear some of the better DX programmes currently on the air.

Our own Radio Australia has a programme, called "Club Forum", which is heard on Saturdays at 2040, with repeats at 0240, 0840 and 1440. The programme presents news of latest DX loggings provided by the Australian Radio DX Club, as well as DX club news from around the world, and answers to DXers' letters. The host of Club Forum is Warren Moulton, and you can hear the programme at 2040 on 9580, 11 725, or 11 855. The 0240 edition is broadcast on 15 160, 15 240, 17 795, 17 870, 17 890, 21 680 and on 21 740. The early evening 0840 programme is heard currently on 6045, 9570, 9670, 11 740, 21 570 and 21 680.

A special feature of the BBC's programme "World Radio Club" is the weekly news from the BBC's own Monitoring Service, reporting on frequency changes, new transmitters and schedule re-arrangements for stations world wide. World Radio Club is broadcast in a new edition each week. Best times for Australian reception of World Radio Club are Sundays at 0745 and 2100, and on Mondays at 1115 each week. Current frequencies for the 0745 programme are 21 710, 15 070, 11 955 and 9640. Try 11 955 for best reception. On Sunday at 2100, try hearing World Radio Club on 11 750, 15 070 or 21 710.

The Monday evening edition at 1115 can currently he heard on 25 650, 21 550, 11 750 and 9740, with 25 650 and 11 750 currently giving best signals.

Also worth a listen is Radio Sweden's "Sweden Calling DXers" which features latest DX tips provided by listeners to Radio Sweden around the world. The programme is a good source of DX news, with a fast moving format without superfluous chatter which tends to plague some other DX sessions.

Sweden Calling DXers is heard every Tuesday evening at 1115 on 21 690. Good news is that Radio Sweden has recently extended the programme 12 minutes. Radio Sweden will also provide DXers with printed copies of the scripts of Sweden Calling DXers free upon request to the station at S-105 10 Stockholm.

Radio Nederland has a programme called "DX Juke Box" which is heard during the Australia and New Zealand service from 0730-0825 on 9770 and 9715, and 0830-0925 on 9715. DX Juke Box is currently heard during the Thursday programme, usually 20 minutes after the start of transmission. The programme includes regular reports from experienced DXers around the world.

A complete list of current DX programmes is contained in the 1980 edition of the World Radio and TV Handbook which should be out around the beginning of February. Should you order your copy from the Australian Radio DX Club, then you will be assured of receiving the 1980 edition just as soon as it has been published in Denmark.

Better signals from Swaziland

A move from the 90 metre to the 60 metre band by Swazi Music Radio has meant better reception of this commercial station here in Australia.

The station broadcasts a mostly pop music format on the new outlet of 4980, replacing 3223, and is audible prior to 2100 in our early mornings. Programmes are mostly in English, and there are occasional religious features.

NOTE! All times are given in Greenwich Mean Time (GMT). To convert GMT to Australian Eastern Standard Time, add 10 hours. To convert to Central Time, add 9 hours, and for Western Time, add 8 hours. All frequencies are in kHz.

Compiled by Peter Bunn, on behalf of the Australian Radio DX Club (ARDXC). Further information on DXing or the activities of ARDXC may be obtained from either PO Box 67, Highett, VIC 3190, or from PO Box 79 Narrabeen, NSW 2101, for a 30c stamp.

loggings

Belgium in two varieties

Radio in Belgium is organised into two separate networks, BRT which is the Dutch language network, and RTB which is for the French community. This dual organisation is also reflected in Belgium's shortwave service.

BRT is responsible for producing the English language overseas service, and until March next year the English programme 0015-0100 is scheduled to be broadcast on 9685 and 6080. For night-owls, there is also an English segment 1705-1750 on 17 740 and 6010. Both English segments carry the DX programme every second and fourth Sunday, at 0045 and 1735.

The French network, RTB, broadcasts Monday to Saturday 0500-0815, and 1030-1330 on 21 460 and 15 210; also between 1500 and 1645 on 21 460 and 5965, with the final segment from 1700 until sign-off at 2130 aired on 15 210 and 21 460. RTB transmitters are located at Wavre and consist of one transmitter of 250 kilowatts (operating on 21 460) and a unit of 100 kilowatts.

Meanwhile, BRT has recently altered its verification policy to coincide with the introduction of Listeners Club by the station. Only members of the Club will be able to receive QSL cards for reception reports, and other items such as pennants will be reserved for Club members. Listeners Club members must submit regular reception reports to maintain Club membership. More details are available from BRT at PO Box 26, B-1000 Brussels.

Changes at Radio Mozambique

Mozambique recently re-organised services on shortwave emanating from the capital city of Maputo (formerly Lourenco Marques).

There is now a National station serving all the country, broadcast 0255-2210 on 9618 and 7240, on 11 820 0500-2210, on 3210 0255-0505 and 1645-2210, and on 4865 0255-0545 and 1545-2210. Best reception is currently on 9618 after 1500, on 3210 up until 2100, and on 4865 until sign-off 2210.

There is a second network from Maputo, serving the two southern provinces, which is currently heard in Australia on 3338 prior to 2100, and on 4855 1600-1730.

Maputo radio also broadcasts the programme of the Patriotic Front, known as "The Voice of Zimbabwe" 1800-1830 in English on 3265 and 4855. Best reception for listeners in Zimbabwe-Rhodesia is presently noted on 4855.

Radio Japan continues relay experiments

Radio Japan is continuing with experimental relay transmissions to the Middle East and Europe via Radio Trans-Europe at Sines (Portugal) during transmission period D-1979 which concludes in March this year.

The Sines relay transmissions are in English and Japanese every day from 2200 until 2230 on 11 735, and between 0700 and 0730 on 15 130.

The transmissions are beamed via a satellite from Tokyo to Sines, and then rebroadcast. This results in about a half-second delay in the Sines programming, as compared to the regular Tokyo frequencies. The 2200 service is beamed from Tokyo on 17 755, 15 195 and 9585. The 0700 programming is broadcast from Tokyo on 17 880, 17 795 and 15 270. The Sines relay frequency of 15 130 suffers bad interference from Radio station Pacific Ocean which has studios in Vladivostok.

Strong voice for Equatorial Guinea

Equatorial Guinea has recently pressed a new 50 kilowatt shortwave transmitter into service, making for much improved reception of this African country here in Australia.

Test transmissions were at first carried out on 11 715, but have since switched to the 60 metre tropical band outlet of 5005. The new transmitter is located at the town of Bata in Rio Muni, the mainland enclave which, along with the island of Fernando Poo, constitute Equatorial Guinea.

Transmissions are in Spanish and a local language, and identify as "Radio Ecuatorial, La Voz de Rio Muni" as monitored on 5005 between 2030 and sign-off at 2130.

DXers meet in Melbourne

The national Convention of the Australian Radio DX club will he held in Melbourne over Easter, April 4 to 6. Members from throughout Australia will be attending. All DXers will be welcome and a registration form for the Convention is now available from the ARDXC.

PREDICTIONS

FEBRUARY 1980

Covering 3 to 40 MHz, these predictions show the times radio contact is possible between the areas designated beneath each graph, as well as the possible 'mode' and reliability. Vertical columns indicate time — commencing at 0000 UT on the left, to 2300 UT at right. For reliable predictions follow the times and frequencies indicated by the F character.

Complete information on using these predictions can be obtained by sending a stamped, self-addressed envelope to:-

ETI — Predictions
3rd floor 15 Boundary St
RUSHCUTTERS BAY NSW 2011.

These GRAFEX style computer generated predictions are provided courtesy of the Australian Ionospheric Prediction Service.

KEY TO SYMBOLS

A blank area means no normal propagation is possible.

% . . . . . path open 50 - 90% of days in month.

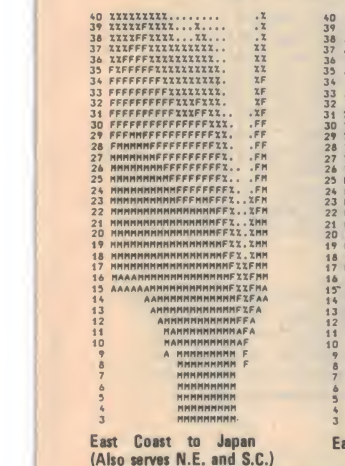
F . . . . . path open at least 90% of days in month.

B . . . . . propagation possible via E and F layers over 90% of days. Overrides 'F'.

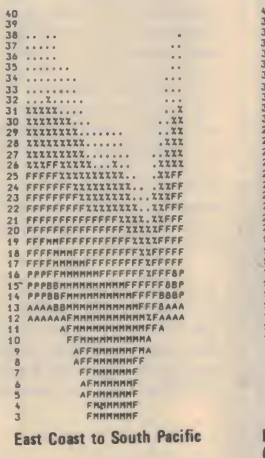
M . . . . . propagation possible by both 1st and 2nd F-layer modes. Expect strong fading.

S . . propagation possible by 2nd mode (also 3rd and mixed E and F modes). Expect strong fading, weak signals.

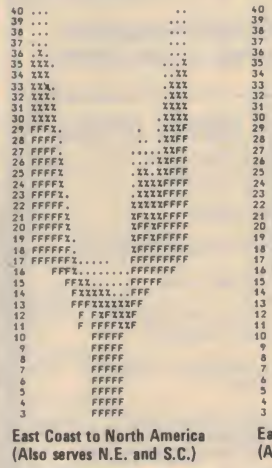
A . . . . . High absorption indicated. Expect weak signals.



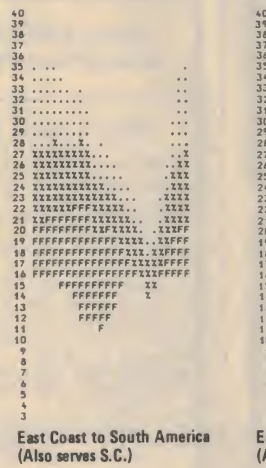
East Coast to Japan (Also serves N.E. and S.C.)



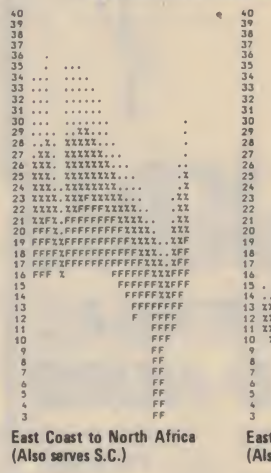
East Coast to South Pacific



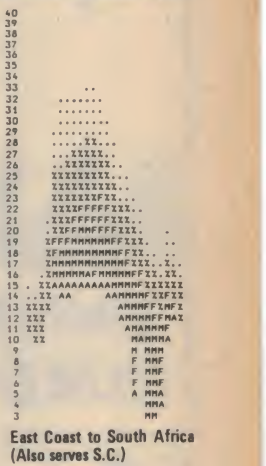
East Coast to North America (Also serves N.E. and S.C.)



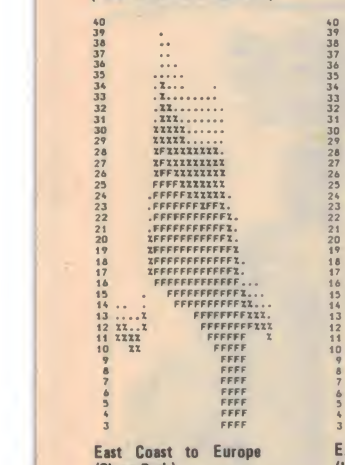
East Coast to South America (Also serves S.C.)



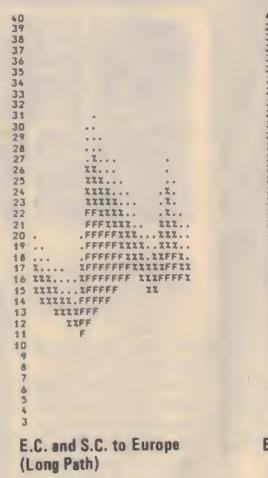
East Coast to North Africa (Also serves S.C.)



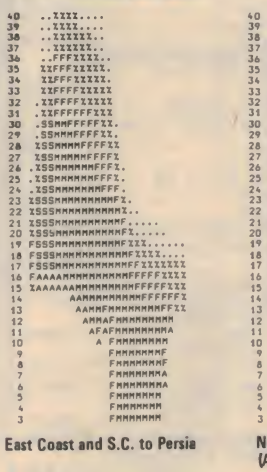
East Coast to South Africa (Also serves S.C.)



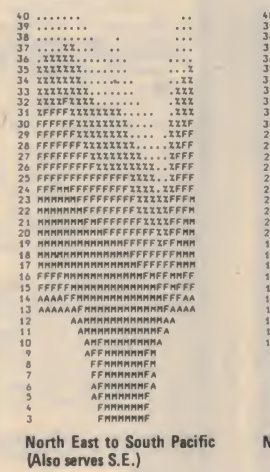
East Coast to Europe (Short Path)



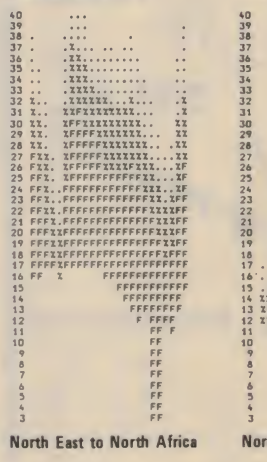
E.C. and S.C. to Europe (Long Path)



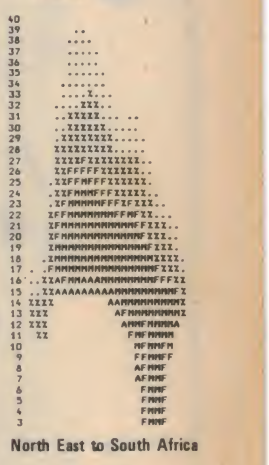
East Coast and S.C. to Persia



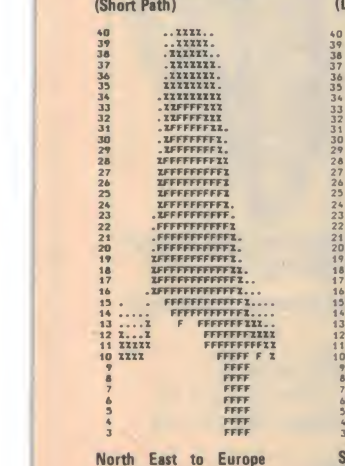
North East to South Pacific (Also serves S.E.)



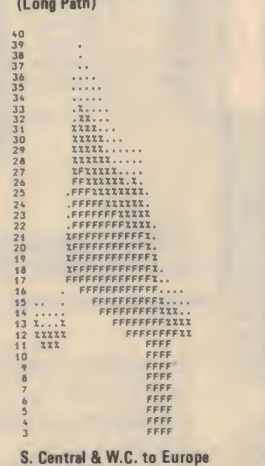
North East to North Africa



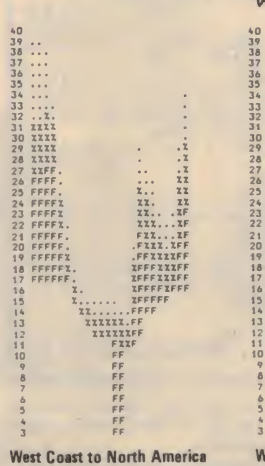
North East to South Africa



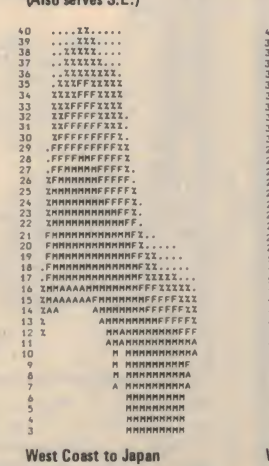
North East to Europe (Short Path)



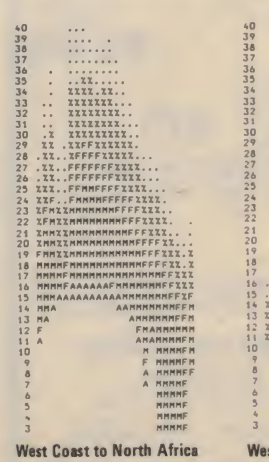
S. Central & W.C. to Europe (Short Path)



West Coast to North America



West Coast to Japan



West Coast to North Africa

West Coast to South Africa

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AUDIO

MELBOURNE Hi-Fi Friends the Recording Society of Australia meets monthly for demonstrations, lectures and live-recordings, etc. Please ring for syllabus and info (03) 459.1717 or write to Don Patrick, 36 Argyle Street, Macleod, Vic 3085.

WANTED: Linn Sondek SP12 turntable without arm. J Coulson, "Rostella", Dilston, Tas 7252, phone (003) 28.1237. Wanted by Xmas.

SELL: Nordmende Super 8 Colour Telecine in first class condition. Ideal for making video tapes from Super 8 films. $1000. Phone (02) 84.6764 AH.

PRO 9TL transmission line monitor speakers - KEF B139, Peerless K040 MR, Son Audax Tweeter; for amps 50W RMS; 39" x 12" x 18" - $1200. R Salter, 33 Belvedaire Way, Lynwood, WA, 350.7254 or 364.5573.

STANTON 681EEE mounted in Denon headshell. Almost unused $95 (my wife can't stand it). John Yelland, 16 Main Street, Lockleys, SA 5032.

FOR sale ETI 427 Equalizer, no cover, $85. ETI 424 Reverb Unit $30. Phone (02) 449.4186 after 4 p.m.

DYNAVECTOR 3000 gold valve preamplifier. As new, personal property of importer. Retail price was $4998, will sell $2250. 12 month warranty. Derek Pugh (02) 938.3700.

SELL hi-fi system, recently purchased. Comprising TEAC amp and spkrs, 50W RMS, with AR120 turntable. $800. Contact K Dahya, 15 Galston Road, Montrose, Tas 7010.

FOR sale four Plessey C12P loudspeakers, 30 W RMS 8-15 ohm impedence. 30 cm - diameter, brand new, must sell. Ring (02) 869.8893 after 6 p.m.

FOR sale SME Tonearm 3009 Series 2 (improved) with Sure V15/111 cartridge and spare stylus $100. (02) 498.2952.

AMW studio monitor speakers SM4100. Almost new. Won in competition $750. New price $995. Peter Coombe, 4A Urrbrae Ave, Myrtle Bank, SA 5064. (08) 278.1489.

EMI BTR/2 professional studio recorder 7.5/15 ft $500; Ferrograph Series 4 ½ track 3.75/7.5 IPS $150; Akai 707 3.75/7.5 IPS $120. All good condition with manuals. Cec Ryan, Brisbane. Phone 44.4641.

SELL: 4 ETI 450 Audio Delay boards ($18 each) + associated Mixer ($6); All PC; use for Reverb, Tremolo, etc. Refer ETI Dec 77; phone David (07) 370.7808.

COMPUTING

VIDEO terminal for sale ETI 632 built in cassette interface, plus recorder. Professionally made top class unit $200. Ring (02) 521.7169.

TVT II two pages 16 lines x 32 char. RS232 loop full cursor control 110 to 1200 Baud Popular Amer Design $275 ONO. Phone Bill (02) 49.1777.

COMPUTER controlled mass storage cassette unit with read/write electronics ½ Meg byte on C60 at 24,000 Baud. $175. Phone Mike (03) 541.2529 BH or (03) 543.3570 AH. Wanted Printer.

TANDY TRS 80 Micro Level 1 BASIC. Two months old never used plus pre-programmed material including personal finance selling complete $745 ONO (07) 263.6223.

PROGRAM exchange for TRS 80. Write Robert Gareb, 17/37-39 O'Donnell Street, Bondi 2026 or phone (02) 30.8261.

SIGNETICS KT9500 (2650) with RSMB, 16k RAM, PSU, manuals and software. All working $400. Colin Rieger, 24 Second Ave, Sefton Park SA 5083.

TRS 80 owners - RS232 serial interfaces to drive your printer without the expansion interface — includes software to use LLIST and LPRINT — no modification to your computer, just plugs in $65. For more info write C/- PO Box 122, Bondi Beach 2026.

SELL: Casio fx-202P pocket scientific-programable calculator, 11 memories, constant program memory. Complete with instructions and programs $75. Phone (02) 451.3737 ask for Andrew.

SELL: Cromemco Z-2D — 48k RAM, 2 mini-drives, VDU: software includes — 16k BASIC, FORTRAN, RATFOR, COBOL, ASSEMBLER and CP/M operating-system. $4600 ONO. G Wieland, 3 Brake Ave, North Rockhampton, Qld 4701. (079) 28.1293.

PAPER tape readers and punches from $25 also paper tape. Tel AH (02) 70.1481. T Ledger, 17 Melanie St, Bankstown NSW 2200.

TI 59, 2 modules, $240: PC100A printer $210: separate or as unit $440 ONO. C Gibbings, 68 Wood St, Dalby 4405. AH (074) 62.2630.

SELL: EA 2650 full I/O provision for 7k RAM unfinished; EA VDU KBD P/S case unfinished $500 ONO. Phone Greg (02) 630.1013.

PRINTERS: Reconditioned. 2 upper/lower case, 150 Baud, RS 232, $350 each. 1 upper case, 110 Baud, 20 MA, $250. Stand $20. Interface, software suit TRS 80 $50. Phone (02) 88.4453.

EA VDU $50. EA 2650 4k $30. 78 UT 4 less 5740 $10. 8 x 2k Ramsticks $30 each. RSMB $15. SEC1 cassette interface $10 or $300 the lot. Sydney 44.5652.

SELL: Heathkit ET 3400 Trainer and EE 3401 course on programming and interfacing M6800 CPU. Cost $470. Sell $400. 6 months old. D Morton, 26 Myrtle St, Murwillumbah, NSW 2484. Phone (066) 72.3335.

APPLESOFT BASIC II in ROM board. Plus manual. $100. (042) 84.3884 after 6 p.m. Dave Henderson, VK2YKQ QTHR.

SELL Miniscamp microcomputer with programs and accessories. Full working order $75.00. Eastwood St, Chandler, Brisbane, Qld 4155. Phone 390.1520.

WANTED: Small cheap computer - consider any computer. VDU and keyboard not needed. Ray Evans, PO Box 36, Iluka 2460. Phone (066) 46.6173 or C/- (02) 669.6475.

USED computer tapes magnetic 2000' x ½" on plastic reels $2 each ONO. Ray Evans, PO Box 36, Iluka 2460. Phone (066) 46.6173 or C/- (02) 669.6475.

CHEAP printer suitable for TRS 80. $60 includes documentation on interfacing and complete program listing. Ex-PMG, uses standard 8" fanfold paper. R Stein (02) 709.4217 AH or WE.

NS Data Books regulator memory CMOS TTL linear transducer 1974-1976 excellent condition $15 complete. Phone Lyle AH (08) 353.1278 Adelaide.

S100 edge connectors, gold-plated, solder-tail, $4.25 ea. Wire-wrap IC sockets, gold. 14 pin - 50 cents, 16 pin - 60 cents. All new. Graahm, AH (03) 89.6918.

FOR sale: SYM1 computer. See ETI Nov 78. Unused, still in original packing. Manual included. Must sell $300 ONO. Al Allerton, RADS RAAF, Laverton, Vic 3027.

FOR sale: Micro-computer ICs. New. 6800 $9; 6820 $5.25; 6821 $6.25; 6852 $5.25. 8080A $8.50; 8255 $7.75; 4 MHz crystals $4.25; 6875 $10.75. Graham AH (03) 89.6918.

SELL MEK 6800 D2 with power supply, card-cage full RAM and buffer. No bugs full documentation. $300 ONO (02) 498.2952.

OSI superboard or C1 owners. Anyone interested in forming a club/users group contact Geoff Cohen, PO Box 73, Lyneham, ACT 2602. Phone (062) 49.3493 (work) or 54.7608 (home).

KT 9500, DG 640 VDU, 10A supply, motherboard, RAMstick, keyboard, etc., attractive F/glass case. Ready for wiring. Cost $526, sell $290. Phone AH (02) 626.9458.

TI 57 calculator programs for sale: one armed bandit, scissors rock paper, clock, nim, mod-hi-lo. $2 each. $4 the lot. Write to S Opat, 4 Moorakyne Ave, Malvern, Vic 3144.

TRS 80 Lev II owner would like to correspond with others. Swap programs and ideas on uses, publications, modifications, etc. R Rider, 36 Osburn Drive, MacGregor, ACT 2615.

TRS 80 or Exidy 16k memory expansion, new, 4116 type chips, $85/16k. Micro-computer ICs, new. Z80A $17; Z80 PIO $12; Z80 CTC $12. Graham AH (03) 89.6918.

SELL DREAM 6800, main board components - 6875 replacement kit; inc pcb $80. Anthony, 17 Kay St, Mt Waverley 3149. (03) 288.2587.

2650 computer, 4k RAM, EA VDU, keyboard, cas int, user's group star trek, micro BASIC, many more programs. See running. $450 ONO. Phone Neville. Bus (03) 707.1331, AH (059) 68.8356.

SELL for SYM-1 and KIM-1 computers, KTM-2 keyboard $350, BAS-1 Basic roms $150, still under warranty, perfect condition, D V Gorza, 1/43 Brookfield Rd, Kedron 4031.

COMMUNICATIONS

TELETYPE Model 15 for RTTY adjusted for 45.45 Baud $50. Transformer 240/130 volt for above $15. Phone CP 521.2637 Sydney.

YAESU FT 101E transceiver in new condition AUX 27 Megs $650. Phone Perth (09) 457.3869.

TS5205 Kenwood with telex microphone, connectors and AC/DC leads $535. Will be sent in original packing "as new". VK3BID. Telephone Dave Burger on (03) 428.4732.

AUSTRALIAN Radio DX Club, for short-wave, mediumwave DXers. Monthly magazine published. Write for details to PO Box 79, Narrabeen NSW 2101 or PO Box 67, Highett, Vic 3190.

WANTED circuit, wiring diagram for Shakespeare GBS 1500 CB. D Rapson, 32 Ridgehaven Dve, Bellevue Heights 5050. Phone (08) 276.1036.

MISCELLANEOUS

WANTED to buy, Automatic phone dialler for burglar alarm system. Write to P H Wilkinson, Flat 30, Block A, Banool Ave, Woomera, SA 5720.

WANTED: A reliable easy to use oscilloscope. Specifications & price to — R J Bardsley, C/-Electricity Division Substation, Ongarue, NZ.

STOLEN: (7th November) HP45, leather case and quick reference guide. Serial No. 1349S-30567. Reward offered. Phone Phil Denniss (02) 646.3504 (home), (02) 692.2693 (work).

WANTED: Radar antenna dish, 18-inch or larger. Needed for directional microphone. Write with details to David Headland, 8 Allen Street, Berwick, Vic 3806.

FOR SALE: 1 microwave oven leakage detector CSIRO design @ $10. 2 tubes Gensil heat conducting paste @ $3 each. Range of 7400 Series ICs from 7400 to 74177. Write to F Sturges, PO Box 5100 MSO, Townsville, Qld.

WAIKERIE Lutheran School is looking for donations of radio studio and tape recording equipment for school project. Send information to school, McCutcheon St, Waikerie 5330.

WANTED copy of Practical Electronics May 1979. B Hubble, 13 Clowes St, Larrakeyah Bks, Darwin 5790.

WANTED: Information where to get, Electronic Pin Ball machine circuit diagram or 2nd hand pin ball machine. Garry Rhodes, 19 Smith Crescent, Wangaratta 3677.

SELL: Three volumes ex cond Rare Psychic Research Electronics circuit diagrams, not for beginner. Will not separate $100. Bortella, PO Box 312, Derby 6728.

AUTOMATIC telephone answering machine, new, cost $349, sell $279. Warranty still covered. Trevor Pearson (02) 349.1691.

FOR sale: (Complete years) ETI, EA, Popular Electronics, Radio Electronics, etc. Also 12V/6V 4A Battery charger ($13), model railway equipment. Phone (02) 982.4048.

SELL: Three-in-one unit: ETI 137 AF Oscillator, 114 Dual Beam Adaptor and 106 'Scope Calibrator. $160. Trio CO-1303 D 5 MHz Oscilloscope. $200. Ring Henry Gonelli (03) 850.8918 AH.

The new generation of factory-built or kit-set Peerless loudspeakers

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Peerless Midrange Units

☐ Sealed back units prevent interaction with the woofer. Distortion and colouration are reduced to a minimum. ☐ The rear side of the cone is coated with a special damping material to eliminate colouration. ☐ Specially impregnated polyurethane cone rim provides high degree of linearity.

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☐ Peerless crossovers use air-cored chokes for maximum power handling, and special electrolytic capacitors to ensure long term reliability. ☐ All components are mounted on fibreglass printed circuit boards for maximum durability, while coded clip connectors eliminate the need for soldering.

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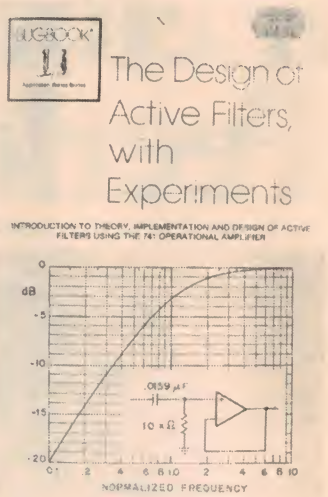
BOOK REVIEWS

The Design of Active Filters, with Experiments, Howard M Berlin, E&L Instruments, Inc. Connecticut, 1977. $10.00

Review copy supplied by Stewart Electronics, 33 Sunhill Rd, Mt Waverley Vic 3149. $10.00



HERE'S AN EXAMPLE of a good practical book which is short on text and long on information content. E&L are, of course, makers of the SK-10 breadboard socket which, together with its competitors, is used in labs and workshops all around the world to quickly breadboard experimental circuits. This board, together with a plug-in signal generator circuit and an oscilloscope, is used as the basis of the experiments described in this book.

The text is type-written, rather than type-set, in the style of college notes; in the reviewer's opinion, this does not harm the book at all — after all, it's the information content that's important. In this last respect, the book scores extremely well.

The experiments are well organised, with procedures laid out clearly, and answers supplied in the form of tables of measurements or answers to 'why?' — type questions. At all times the student is encouraged to think, which is the only way to really learn. **Les Bell**

Home Computers: A Beginners Glossary and Guide, Miller and Sippl, dilithim Press, Portland Oregon, 1978.

Review copy supplied by Computerland Australia, 55 Clarence Street, Sydney 2000. $10.05

THE MAJOR SECTION of this book is a glossary of electronic and digital logic terms and unlike many dictionaries one comes across today, this one is relatively up-to-date and relevant to the user. It doesn't go into diatribes about IBM's JCL (job control language) or OS/MVS or other acronyms perpetuated by the high priesthood of big systems. Instead, it talks, with remarkable clarity, about the card cages, CMOS and DACs — topics much more appropriate to the microcomputer. A few more illustrations might have helped though.

The rest of the book is more conventional. There's the usual bit of 'gee-whiz, computer explosion' stuff, followed by general background rambling about computers in general and microcomputers in particular. The authors obviously have been involved with microcomputers for some time, as there is plenty of information in this section.

An interesting book, that doubles as a good read and then as a reference book on the shelf. **Les Bell**

Peanut Butter and Jelly Guide to Computers, Jerry Willis, dilithium Press, Portland, Oregon, 1978.

Review copy supplied by Computerland Australia, 55 Clarence Street, Sydney 2000. $11.35

THIS IS ONE of the best general introductions to hobby computing that's available at the moment. Notice that I said *hobby computing*, not 'home computing' — this book is not intended for owners of some of the glorified TV games now posing as computers (dig, dig!).

The various chapters of the book describe the operation and hardware organization of the component boards of a typical microcomputer, mostly S-100 stuff, but with PETs, Apples and TRS80s thrown in. Memory, both on- and off-line, is discussed in detail as well as I/O. All kinds of peripherals, including VDUs, printers and modems, are described in general terms.

Several other chapters describe software, both systems and application, then follow several chapters devoted to more general topics, such as specialised applications (e.g: graphics), comparison of computer types, the hazards of buying by mail order, and so on.

The overall style is light, yet informative. Highly recommended. **Les Bell**

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Dimensions in cm:	53.5(h)x32(w)x22.6(d)	62(h)x39.3(w)x29.3(d)	71.7(h)x47.5(w)x29.3(d)
Frequency Response:	45Hz - 20kHz	35Hz - 20kHz	28Hz - 20kHz
Impedance:	8 ohms	8 ohms	8 ohms
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THE "GRAMOPHONE" TESTS CELESTION'S NEW DITTON 551

Celestion Ditton 551 Loudspeaker

Manufacturer: Rola Celestion Ltd., Ditton Works, Foxhall Road, Ipswich, Suffolk, IP3 8JP.

My first introduction to Celestion loudspeakers was around 1925 when they were demonstrated daily in the Peto-Scott showroom in High Holborn. At that time the moving-coil loudspeaker was unknown to the public, although an experimental model was described in the *Wireless World* in August 1926, and later that year BTH showed the first commercial moving-coil unit at the Olympia exhibition. The Celestion loudspeaker was one of the first to be mounted in a cabinet and used a large free edge diaphragm. This was made from a very thin parchment-like material, stiffened with a spiral and driven by a large balanced armature, compound magnet system. The *Wireless World* described it as "a really good loudspeaker, the quality is distinctly good although the tone may be slightly on the loud side" — whatever that may mean! From those early days Celestion loudspeakers have maintained a high standard and, except for one excursion into the electronic field with the Celestion Telefi pickup unit which enabled one to take a signal from a television receiver and apply it to a better quality amplifier and loudspeaker, Celestion have always concentrated on manufacturing loudspeaker units and enclosures.

Ditton 551 with grille removed

The cabinet of the Ditton 551 is constructed from 18mm thick dense particle board, finely veneered with American oiled walnut on both sides and all inner surfaces are covered with thick acoustic absorbing material. The front baffle is recessed so that the three drive units and the twin constant-impedance attentuator panel is flush with the baffle. The baffle also carries a plastic vent to improve the bass response. Recessed into the rear panel is a board carrying two terminals for 4mm plugs. A substantial 22mm thick wood frame supports a newly developed grille material, with six offset plastic studs to hold it against the front panel.

The mid-range and treble units are mounted asymmetrically in relation to the centre line and bass unit. When used in pairs for stereo reproduction, the speakers should normally be positioned with the mid-range and treble units innermost, to obtain the smoothest frequency response and directional characteristics.

The newly developed bass unit consists of a massive 290mm diecast aluminium chassis carrying a 2.9kg barium ferrite magnet. The diaphragm is made from a fibrous material with a lossy mass at the junction with the voice coil and a PVC roll surround terminates the diaphragm edge. The voice coil is 50mm in diameter and supported on a glass fibre laminated former which is able to withstand high temperatures. Free air resonance was measured at 45Hz but, when mounted in the reflex vented cabinet, the −3dB point falls to 38Hz.

The MD701 mid-range unit also uses a massive 2.7kg barium ferrite magnet mounted in a diecast aluminium mounting plate. A 46mm diameter voice coil drives a PVC impregnated cellulose fibre woven soft dome diaphragm. To protect the diaphragm, a dished 135mm diameter open weave gauze cover is fitted. The HF2001 treble unit has a barium ferrite magnet weighing 0.65kg. A 19mm polyamide impregnated voice coil drives a hot pressed polyethylene terephthalate polymer diaphragm which is also protected with a black metal grille.

The 15-element dividing network makes use of reversible electrolytic capacitors, air and ferrite cored inductors. The mid-range and treble units have 3rd order Butterworth filters followed by constant impedance variable attenuators. Mounted on the attentuator plate is a fuse to protect the treble unit and, if this fails, a LED indicator is illuminated and continues flashing until the fuse is replaced. Both attenuators are capable of giving 2dB boost or up to 6dB cut and also include a compensating network which maintains an 8-ohm resistive load, thereby smoothing the impedance curve.

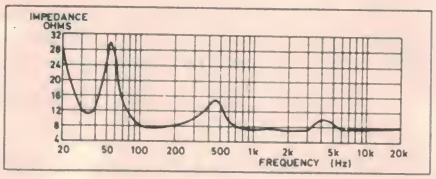


Fig. 1 — Impedance with frequency

SPECIFICATION AND TEST RESULTS
CELESTION DITTON 551 LOUDSPEAKER

	Maker's Specification	Test Result	Reviewer's Comments
1. Type	Three-way reflex	–	–
2. Drive unit diameters(mm)	290, 50, 19	–	–
3. Frequency response (Hz)	38 – 20,000 ± 3dB	Agreed	–
4. Crossover frequencies (Hz)	600 and 4,500	Agreed	Sensible choices, well within the range of each unit
5. Nominal impedance (Ω)	8	See Fig. 1	Does not fall below 7 ohms
6. Power handling capacity	140 watts (music) 22 volts bass 14 volts mid-range 11 volts treble	Agreed	Will cope with amplifiers rated 20 – 140 watts
7. Distortion	2nd and 3rd harmonic 2% at 20Hz. Less than 1% above 100Hz	–	No audible distortion at high domestic volumes
8. Sensitivity	3.25 watts peak noise for 90dB SPL at 1 metre in Anechoic room	3.1 watts in open air	–
9. Dimensions (mm)	720 × 395 × 328	= 28½ × 15½ × 13"	–
10. Finish	Oiled USA walnut elm or black ash	–	–
11. Special features	Mid-range and treble level controls	–	–

M&G/a3

Speaker Positioning

Nearly all loudspeaker manufacturers offer suggestions as to the positioning of their loudspeakers in the listening environment. Usually they suggest that the distance between the speakers for stereo should be around 3 metres, but they seldom offer information as to the effect of placing the speakers near the room boundaries. Celestion engineers have measured the effect of placing the loudspeakers in three posssible positions and their response curves are shown in the user's leaflet. They market a neat square-section steel stand that raises the loudspeaker some 250mm (10 inches) above the floor level.

Loudspeaker positioning is further complicated by the effect of the ceiling, shape of the room, and the wall construction. Therefore one should experiment by moving the loudspeakers around until one finds an acceptable and smooth performance. The Ditton 551 is designed so that when mounted on the Celestion stand, with the centre of the bass unit further than 400mm from any wall, the bass response will be optimum.

Figure 1 shows that impedance never falls below 7 ohms, making the loudspeaker suitable for any modern amplifier. As the attenuators in the treble and mid-range unit filter circuits are followed by impedance compensators, the overall impedance is not changed when one varies the mid-range and treble controls. The power handling capacity of the Celestion 551 is far greater than one would require for normal domestic purposes and, for the past few months, they have been used with a Luxman L-100 amplifier capable of delivering a maximum power output of 110 watts per channel. Using a peak reading meter, I found that even with highly modulated records the power delivered to the speakers seldom exceeded 30 watts for loud domestic listening. The overall frequency response is substantially flat from 40Hz to 20kHz, with the mid-range and treble controls set to the flat position.

Listening to many FM transmissions I found that in my lounge the best position for the mid-range control was flat, whilst I preferred advancing the treble control to plus 1 or 2 — probably due to slight loss of hearing above 14kHz with my advancing years.

Experiments showed that with the speakers positioned about 3 metres apart, 1.5 metres from the rear wall and 1 metre from the side walls gave the most pleasing results. I was particularly impressed by the accurate stereo imaging. As an experiment, the loudspeakers were reversed in position, that is with the mid-range and tweeter units outwards, and there is no doubt that one loses the directional accuracy. Low frequency response was clean and neutral, its extension downwards dependent on the speaker positioning and the size of the listening room. On male speech there was a slight tendency to plummyness, though on music the bass was clean and had good attack. Mid-range response could be altered over a wide range with the control, and normally gave excellent separation and clarity. Turning the control to the −6dB position lost much of the clarity and definition, whilst at the +2dB position it brought forward the mid-range tones quite noticeably. The extreme top response was notable for excellent transients and smoothness, a legacy from many years of producing high quality tweeter units used in other manufacturers' products and BBC monitoring loudspeakers.

On direct broadcast transmissions, such as the Mozart *Magic Flute* from Covent Garden, one noted the excellent definition and smooth transition from one speaker to the other as the characters moved across the stage, a feature sometimes lacking in less precise loudspeakers.

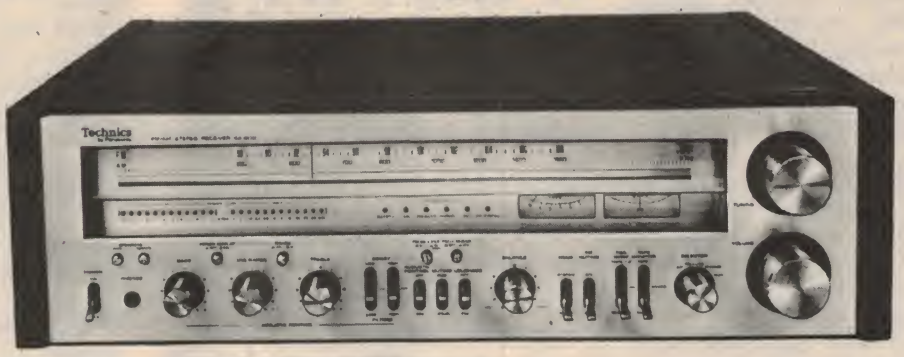
Summing up, this must be the most musical loudspeaker I have so far heard by Celestion. It is perhaps rather large for some living-rooms, but, if it can be accommodated, it is well worth having a demonstration in one's own home. Impressively finished, whether one leaves the acoustic grille on or not, it should meet all the demands of domestic reproduction. There are two sister designs, the Ditton 442 and Ditton 662 which are also worth investigating.

John Gilbert.

Reprinted from "Gramophone" May, 1979.

fact: calling this a "brush"

is like calling this a "radio"



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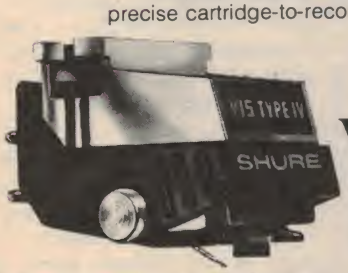

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AE133/FP

Introduction to multitrack recording

Ron Keeley

Multitrack recording in 'home' studios has proliferated in recent years. Many bands and small groups feel the need to make multitrack tapes for a variety of purposes. Want to get in on the act? Read on . . .

MULTITRACK TAPE recording was a development which revolutionised the professional recording industry. The advantages of multitrack recording are now available for the amateur recordist at little more than the cost of a quality hi-fi system.

When the first stereo albums were issued in 1958, two and three-track tape recorders were used throughout the recording industry. Multitrack recording began in the early '60s with the introduction of four-track machines; by the end of the decade eight-track was standard and the new order was firmly established. Today sixteen-track is the most common format, though many studios are using 24-track and some are equipped with monster 32-track machines.

Recently multitrack recorders have appeared on the domestic market, and four-track recorder/reproducers offering professional facilities are now available for little more than domestic hi-fi prices.

Brief history

The recording industry began in 1889 with the release of the first 78 rpm shellac disc, and many different disc formats were tried before the micro-groove record was released on the American market in 1948. Microgrooves were slow to gain acceptance, but by 1958 the 33 1/3 rpm disc format had conquered all.

While discs were undergoing this slow revolution, recording methods were undergoing a parallel evolution. The earliest disc (or cylinders) were recorded acoustically, via a large horn, and it was not until 1927 that electrical methods became widely used for recording music — marriage of the telephone and the gramophone, so to speak — even in 1927, Thomas Edison himself was still recording acoustically.

The recordings of that era were 'transcription' recordings. The live sound of the band/orchestra was transferred directly to disc — a method recently revived, albeit using more sophisticated technology. The use of magnetic tape as an intermediate stage in the recording chain did not come until after WWII. Those early recorders were half-track mono machines and the only possible recording technique was still the the old 'transcription' method.

Everything was recorded at once — instruments, vocals, choirs, every part in the score — and with luck the result was a master tape from which a record could be 'cut'. There was very little creativity in the recording process. The balance of instruments, voices and so on that was recorded was the final balance. If the french horn was too loud it was too bad; nothing could be changed. And there was no margin for error: it needed only one person to make one mistake to ruin the recording. If the soloist fluffed a note, or the recording engineer forgot to hit the Record button (it happens) the take was useless. (The term 'Take', signifying a recording event as in "Take 58 lads. Let's get it right *this* time", may well have derived from 'mis-take').

The technique

Multitrack recording eliminated most of the problems of live or 'transcription' recording. The problem of the 'mis-take' is largely overcome because, with multitrack recording, it is possible to record each instrument entirely separately (if necessary) from each other instrument in the band or orchestra. This is possible through the technique of 'overdubbing', which allows new performances to be recorded in time with previously recorded material. This is *not* possible with normal two-track (or quad) recorders because of the physical arrangement of the record and playback heads.

As tape travels from supply reel to take-up reel it passes, first, the erase head, then the record head and finally the playback head. The program is therefore played-back some time after it is recorded — which is the idea of off-tape monitoring. This means, however, that while a new vocal performance could be sung in time to a previously recorded instrumental backing (monitored off-tape by the playback head) it will actually be recorded out-of-time with the instrumental which has already passed the record head! On playback there will be a time-difference between the two recordings equal to the tape speed divided by the distance between the record and playback heads.

Not only does the technique of over-dubbing allow mistakes to be corrected — because each instrument was recorded separately a mistake on one track can be 'fixed' by re-recording that track alone without affecting the other four, eight or sixteen tracks — but it makes possible new creative techniques through the ability to 'layer' tracks. Multitrack recording has made possible the 32-instrument one-man-band!

Finally, because each instrument can be on a separate track, a multitrack tape can be played-back and 'mixed-down' — the four, eight or sixteen tracks combined into two — many different times in many different ways. The mix-down engineer and record producer have complete control over the volume and tone of each instrument so that variations in the balance tonal quality can be tried and effects such as Echo or Phasing added experimentally before being committed, finally and unalterably, to vinyl.

The multitrack recorder

A multitrack recorder will have, as the name suggests, multiple heads. Each of the three head-blocks (erase, record and playback) of a four-track will have four separate heads per block; an eight track will have eight heads per head-block, and so on. Since the introduction of multitrack recorders, miniaturisation technology has steadily reduced the physical size of head-gaps, while keeping the channel cross-talk to a reasonable level. The latest developments in miniaturisation have made possible domestic four-track recorders using the standard 25 mm tape format.

The term 'four-track' is sometimes inaccurately used to describe stereo (¼-track) tape recorders. The misuse of the term comes from the fact that a stereo tape can be 'turned over' and a second stereo program recorded in the opposite direction. In fact a ¼-track stereo recorder has two-track recording capacity only. A quad recorder which, by definition, has four-channel recording capability is nevertheless not a true four-track because it does not have the capability of synchronous over-dubbing — recording new material in time with previously recorded tracks.
It is these two factors — simultaneous recording on all tracks, and the sync overdub capability — which define a true multitrack recorder.

The real secret of multitrack recording is that one or more of the recording-head gaps may be used for playback. This means that a program may be first recorded then, later, played from exactly the same physical location; simultaneously, other performances can be recorded on one or more of the remaining tracks (sync overdub). The technique is known by various names. Ampex, who pioneered the method, copyrighted the term Sel-Sync (short for Selective Synchronisation); Teac, one of the first manufacturers to develop domestic four-tracks, use the term Simul-Sync; the more general term is 'Sync Overdub'.

The one drawback of sync overdub techniques is that a record head is not especially suited for use as a playback head; its output is lower, and its frequency response narrower, than a well designed playback-head output. For this reason a separate playback or monitor head is provided on all multi-track machines for full fidelity reproduction during mix-down operations.

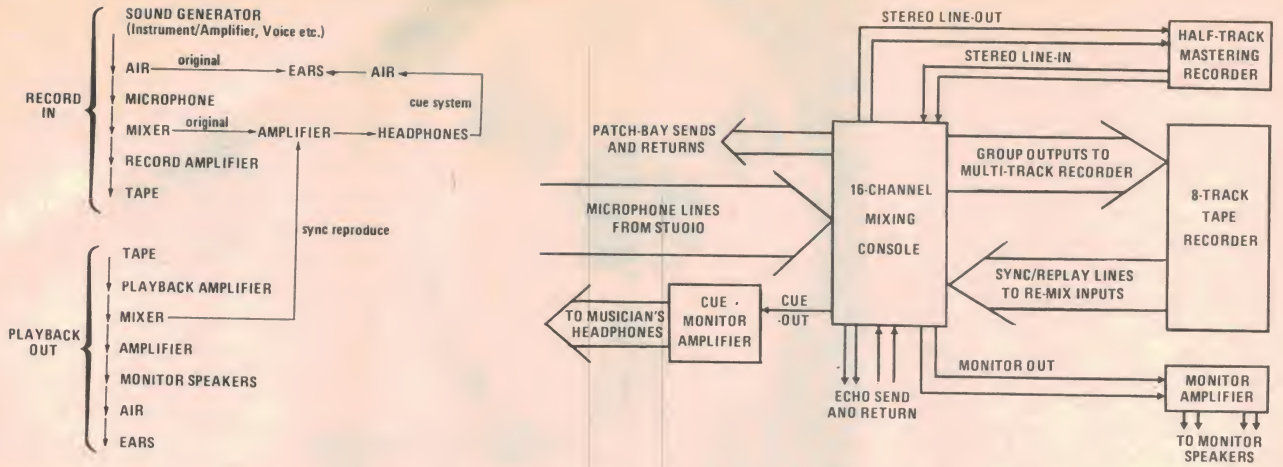
The principle of multitrack recording, then, is that instrumental or vocal performances can be recorded separately, yet in time with each other, while maintaining the quality of the recording process. After recording, the four (or eight, or sixteen . . .) tracks are played back and combined into two (mixed-down) for recording in stereo. This allows great flexibility in both recording and mixing.

Each musician can be recorded entirely separately. If a musician is having an 'off' day, the performance can be repeated as many times as necessary without affecting any previously recorded material. And unlike two-track recording where the balance of instruments achieved while recording is the final balance, a multitrack tape can be mixed-down many times.

Professional mutitrack machines (usually called recorder/reproducers, emphasising the dual role of the sync-overdub head) are available with capacities ranging from four to thirty two tracks from companies such as Ampex, Studer, MCI and Telefunken, to name but a few. Professional four-track recorder/reproducers operate on a half or one inch (13 or 25mm) tape format, eight-track on one inch (25mm), twenty four and thirty two track on two inch (50 mm) tape.

Domestically, four-track recorders operating on a quarter track (25 mm tape) format are marketed by Teac, Akai, Sony and Otari. Many of these domestics, such as Teac's A-2340RS, are quad recorders only, while others like the A-3340, also from Teac, are equipped with the Simul-Sync facility which allows true four-track recording.

The main difference in appearance between a four-track and a typical stereo recorder is in the number of input and output channels. Instead of two there will be four, each having a level control and meter. A four-track machine will have three heads: erase, record/reproduce and monitor. ▶



The Recording Chain (left). Simultaneous recording and playback, on different tracks, is made possible by the sync-reproduce facility. In mixing-down, a stereo output from the mixer is recorded on a separate "mastering recorder". Block diagram (right) shows the basic interconnection of equipment for an eight-track studio.

Doing it

Typically the three heads will be controlled by three output select switches – input, sync and monitor – in conjunction with the main record button and the individual function select switches (ready/safe) of each channel. Combinations of switch positions determine which channels will be in record mode, which channels will be in reproduce, and the point from which the playback signal is 'picked up'. When input is selected the channel inputs are simply fed back to the output lines; this position is normally used only for calibration and initial set-up procedures. Normal recording and overdub operations are carried out in the sync position. With this switch selected the Record/Reproduce status of each of the channels is determined by the position of the corresponding ready/safe switch. In ready, a channel will be in the record mode whenever the main record button is operated. In safe, no erasure or recording can take place, even when the main record is operated. Instead the head, or heads, in safe will reproduce the material previously recorded on those channels in synchronism with new material being recorded on those channels in the ready position. This is the basic principle of multitrack recording!

Finally, monitor selects the playback head (Monitor) for checking the recording, and for full quality reproduction.

Actually there are two ways to enter record mode with a multitrack. The first is to set the required channel function switches to ready, then go into record. This method is used when recording backing tracks (accompani-▶

continued on p.127

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NSW 2069
Ph: (02) 406 5666

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Adelaide,
SA 5000
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Top AMPEX REEL to REEL TAPE at one-third normal price!

The USA Ampex Corporation has made available a substantial quantity of 'off-cut' tapes from their highest grade material. All tapes are 1800 ft (549 m) by ¼", 1 mil ferric oxide on standard 7" reels.

There's a slight gamble involved — but one in which you either win a lot — or a hell of a lot!

Here's why:
The tapes offered are of differing types and you take pot luck on which you receive.

BUT, The lowest quality is Ampex' superb Ampex Plus series! The highest is Ampex' Grand Master series!

SO. If you draw the Ampex Plus' you'll be paying about one-third the usual price. If you score the Grand Masters you'll be paying about a quarter usual price.

YOU CANNOT LOSE. If you are not totally and completely satisfied with your purchase, Dindy guarantee to return the full purchase price without question provided the tapes are returned within 14 days in the original packing.

Identical tapes to those offered are marketed in the USA by Ampex, using the trade name 'Shamrock'. This trade name is also used for those offered here.

NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and this publication is acting as a clearing house only. Cheques should be made payable to 'Ampex Tape Offer' and sent, together with the order form or accompanying letter, to 'Ampex Tape Offer', c/o ETI Magazine, 15 Boundary Street, Rushcutters Bay NSW 2011. We will then process your order and pass it on to Dindy, who will send you the goods. Please allow up to four weeks for delivery.

Owing to the exceptionally low offer price, the minimum ordering quantity is ten tapes (total $39).

$39 for 10 reels

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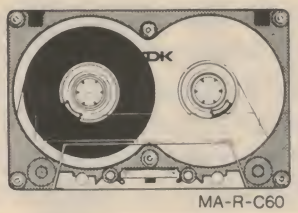
METAL — MA-R developed for decks with Metal Bias position with an outstanding capacity to record high level signals without risk of tape saturation.

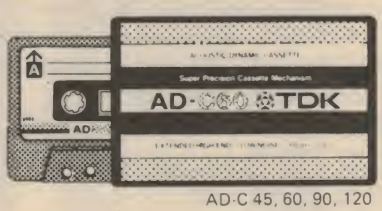


MA-R-C60

SUPER AVILYN — SA handles exceedingly high signal inputs without distortion due to increased MOL providing full dynamic range for both recording and playback.

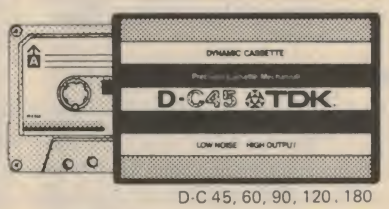
SA-C 60, 90

ACOUSTIC DYNAMIC — AD has high MOL and is capable of recording playing pop rock and jazz music sources with plenty to spare but does not require special bias and equalisation settings.



AD-C 45, 60, 90, 120

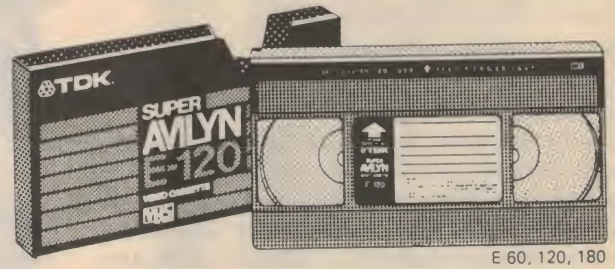
DYNAMIC — D offers sound reproduction quality which meets the budget-minded demands of many home recordists.



D-C 45, 60, 90, 120, 180

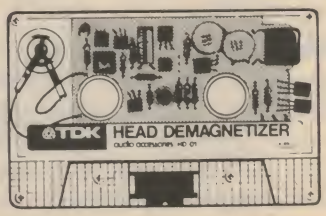
TDK's super precision cassette mechanisms feature —
• Leader tape effectively acts to clean heads • Moulded cassette shell • Double clamp system prevents tape deformities • Pressure pad provides reliable tape contact on the head • Liner enhances tape run and durability • Guide roller ensures parallel tape travel and stable transport.

SUPER AVILYN VIDEO produces crystal clear and colourful pictures with playback images. Excellent durability for use time and time again with compatibility for unrestricted use in VHS system VTR's.



E 60, 120, 180

HD-01 HEAD DEMAGNETIZER — designed by TDK for easy, convenient head demagnetisation of any cassette deck insuring crystal clear, perfect recordings every time.



For more information or a copy of the "TDK guide to better recording" phone or write.

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TDK7558

Only Toa lets you provide top-quality sound with a customized sound system.

Now, at last, you can offer professional-level sound quality with a system that satisfies the experts. Ideal for auditoriums, churches, stadiums, hotels, convention centers and other similar places, the Toa VMS-2000 is amazingly flexible and can be customized to provide no more and no less than is needed for an endless variety of installations. A custom-made, top-quality sound system from Toa. Meet 4 representative components now, with many more to come in the near future:

Preamplifier/Mixer

(Main Frame B-2000 plus choice of Units)

Easily adapted for individual needs. Consisting of a main frame (B-2000) and a wide variety of plug-in units, this system has preamplifier, power supply and signal generating sections*, plus a line amplifier (2071), meter unit (2072) and hi/lo pass filter with tone controls (2073). Mixing busses provide automatic connection for up to 10 functional units (9 with the line amplifier).

Preamplifier Section: Microphone Preamplifier (2051), Microphone Preamplifier with Compressor (2052), Phono Preamplifier (2054), Auxiliary Preamplifier (2054), Balanced Line Input Preamplifier (2056).
Power Supply Section: Power Supply Unit, 500 mA max. (2081), Power Supply Unit, 1A max. (2082).
Signal Generating Section:
Chime Units—A series of 4 notes (2011), 1 note (2012).
Signal Generators—Pink Noise/400Hz/1 KHz (2013).
Siren/Yelp/Buzzer (2014).

1/3 Octave Equalizer (E-2300)

Ideally tailors sound system frequency response to listening area acoustics. Consists of 28 active inductor-less band rejection filters from 31.5Hz to 16,000Hz. Attenuation for each filter is 15dB, and crossover between adjacent filters is −7dB.

Power Amplifier (P-2240)

Delivers 240W RMS continuous power into 8 ohms with less than 0.25% THD over 20—20,000Hz. Features include balanced and unbalanced 15,000-ohm inputs, full protective circuitry, front-mounted AC/DC fuses and two LED indicators for power and overload (power LED turns from green to red for excessive temperatures or voltage drift). 120W amplifier also available (P-2120).

Amplified Monitor (M-2200)

Equipped with large, easy-to-read VU meter and 4" high-compliance speaker. Controls include 4-position meter range selector (20dB, 10dB, 0dB, OFF), 5-position line selector and speaker volume control. Passive monitor also available (M-2100).

P-2120 (120W) also available.

M-2100 (Passive Monitor) also available.

TOA ELECTRIC CO., LTD.

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED
554 Parramatta Road, Ashfield, NSW. 2131. Phone 797-5757.

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Sound

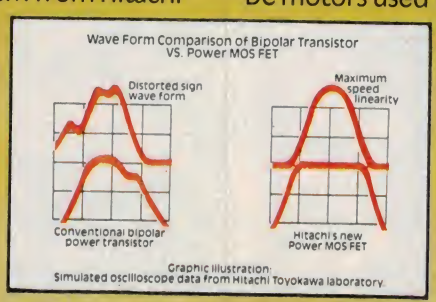
HITACHI

High fidelity. Natural sound

A super system based on the power MOS FET Amplifier HA 5700.

The high fidelity and natural sound concept together give pure performance in this super system from Hitachi– examples of Hitachi's advanced Hi Fi technology. The amplifier incorporates power MOS FET devices–another Hitachi world first. MOS FET (Metal Oxide Semi Conductor) is a new development which enables superior performance to conventional bipolar transistors giving the lowest possible distortion over the widest possible frequency range.

The turntable features the revolutionary Hitachi Unitorque motor system which delivers smooth unfluctuating torque for extremely low wow and flutter and high signal to noise ratios. With unitorque there is none of the cogging or pulsations associated with conventional DC motors used in most direct drive turntables.



Graphic illustration:
Simulated oscilloscope data from Hitachi Toyokawa laboratory.

Other features and Hitachi developments include the power assisted soft touch mechanism and digital fluorescent metering of the cassette deck and of course a dynamic responsive 3 way speaker system and the precise reception of the solid state tuner.

And what does all this add up to? Performance. Pure and simple.

The facts and figures may look impressive but the real judge is you. Listen to Hitachi soon.

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sound news

Philips' introduce "Series 80"

Featuring 'top-shelf' performance and understated, 'class' styling Philips' set of ultra hi-fi audio components, dubbed 'Series 80", feature wide dynamic range, "leakage-cancelled" low-noise power supplies and calibrated controls.

There are five components in the range: a digital tuner, AH180; a preamp, AH280; a stereo cassette deck, N2537, a programmable timer, and a power amp, AH380.

All feature similar styling — black with white detailing — and all units are designed for rack mounting.

The AM/FM tuner features automatic key-in tuning, auto station search (and manual search), up to 12 'memorised' channels, and tuning 'lock'. The front panel is dominated by a LED digital frequency display and all controls are tactile pushbuttons.

The preamp features a wide dynamic range, low noise, wide bandwidth dc amplifier, precision-equalised high-overload phono inputs and precision-calibrated tone controls. A high filter and a subsonic filter are included. It also includes full tape recording and playback facilities and three outputs — direct, switchable and plus 10 dB.

The AH380 power amp is rated to deliver 100 W RMS per channel (into 8 ohms) at a THD of 0.05% across 20 Hz to 20 kHz. It features a wideband dc amp for low TID and a low noise FET input. There are two large calibrated power meters on the front panel for level monitoring.

Your local Philips dealer can provide more information.

Yamaha "weighs in" to the turntable stakes

Yamaha's YPD71 turntable uses the 'super heavyweight' principle together with vibration-absorbent buthyl rubber leg insulators to reduce the effects of acoustic feedback.

The turntable weighs 11 kg (24½lb) — so heavy that it won't mistrack even if you give the base a good thump, according to Yamaha! The platter alone weighs 1.8 kg and the acrylic dust cover 1.1 kg.

The lightweight aluminium tone arm is longer than normal, at 242 mm, to keep tracking error to a minimum.

The gimbal support assembly for the tone arm turns with the arm on low friction, rubber-bushed bearings, markedly reducing the load on the arm's movement. As the assembly moves, the double fulcrum ensures the arm can only move in the vertical direction so that the arm does not slew sideways on a warped record, giving a false stereo image.

The platter drive comes from a slotless servo motor featuring an exceptionally high start-up torque so that the platter quickly comes up to speed.

Actual platter speed is controlled by a quartz crystal-referenced phase-locked loop (PLL) system that maintains the platter speed even under unusually high loads, according to Yamaha.

The YPD71 is priced at $395, making it attractive to the 'middle market' buyer who wants good performance at a reasonable price. Further information is obtainable from Rose Music, 17-33 Market St, South Melbourne, Vic 3205, (03) 699-2388.

Hi-Fi books from Butterworths

A number of Hayden books for the hi-fi enthusiast were released here recently by Butterworths.

Written by Murray P. Rosenthal of RCA Communications, there are four in the series:

How to Select and Use Record Players (112 p)
How to Select and Use Hi-Fi & Stereo Amplifiers (122 p)
How to Select and Use Loudspeakers & Enclosures (90 p)
How to Select and Use Hi-Fi and Stereo Equipment (264 p)

Each includes a chapter on basic sound and hi-fi theory (with the curious inclusion of quad — which we thought was history). The books are copiously illustrated with clear, well-annotated diagrams and photographs. This, and the simple text makes them easy reading. The last on the above list is a composite of the first three with the addition of chapters on tuners and receivers, tape recorders and troubleshooting, but minus the useful material in the others on buying and maintenance of equipment.

They're well worth a look if you're new to the hi-fi game. Contact: Butterworths Pty Ltd, 586 Pacific Highway, Chatswood NSW 2067.

Moving-coil from Audio-Technica

The Maurice Chapman Group released the latest Audio-Technica moving-coil cartridge here late last year, the model AT-30E, along with the companion step-up transformer, the AT-630.

The cartridge features a claimed frequency response from 15 Hz to 15 kHz and an optimum tracking force of 1.4 g to 2 g. The stylus carries a 0.3 by 0.7 mil elliptical diamond and the literature quotes a dynamic compliance of 85 nm per dyne, offering high trackability.

The coils are mounted in a V-configuration — the same as that of a cutter head, claim Audio-Technica.

Total weight of the cartridge is only 5.0 g and the load resistance is quoted at 'more than 10 ohms' and capacitance 150 pF.

The AT-630 transformer is for cartridges with impedances lower than 20 ohms, according to the literature, has a response of 15 Hz to 15 kHz, and distortion of less than 0.05 percent (at 1 mV).

For more information on these and other Audio-Technica products, contact the Maurice Chapman Group: Sydney 438-3111, Melbourne 818-1730, Brisbane 44-7566 and Perth 446-5679.

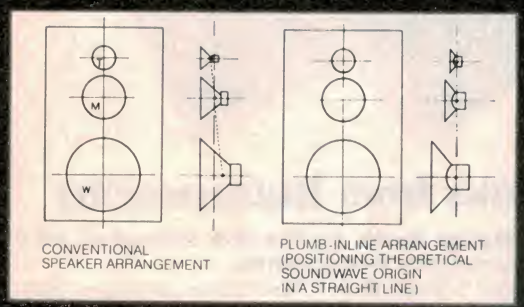
Sony gives it to you straight

When the Sony engineers developed the three-way range of speaker systems they did so with one simple principle in mind.

The end result must be as close to the original programme source as possible.

And as one might expect, Sony have come up with the answer.
And Sony's unique answer was the Plumb-Inline speaker arrangement.

Quite simply it means that each speaker unit is aligned so that its sound wave origins, rather than its front edges, are at an equidistant point from the listener.



CONVENTIONAL SPEAKER ARRANGEMENT

PLUMB-INLINE ARRANGEMENT (POSITIONING THEORETICAL SOUND WAVE ORIGIN IN A STRAIGHT LINE)

As you would expect from Sony, the results are superb. Frequency response across the entire audible range is smooth, stereo imaging and presence are improved and sound is clear and transparent.

In fact Plumb-Inline is only one of the many features of the Sony three-way speaker system.

It also features the A.G. (Accoustical Grooved) Baffle Board.

The baffle board has great influence on sound, especially in the mid-to-high frequency range. It not only weakens presence, but makes musical instruments and vocalists fuzzy. Sony's A.G. board effectively works at eliminating such influences, clearing sound and improving presence.

As a further development the system also features Computer-Assisted Design.

Here the Woofer, Mid-range and Tweeter Driver have each been designed based upon repeated listening tests and through the application of NASTRAN – a computer programme originally developed for the U.S. space programme and first used in the Apollo Project for studying vibration patterns under rapidly changing stress conditions.

These very real technical advances result in greater reality and presence through the reproduction of magnificent natural sound. Which is why people choose Sony in the first place.

Sony G-series and V-series speaker systems are available from around $300 to just under $900 each.

SONY®
AUDIO

An 'affordable' Accuphase amp.

Featuring power MOSFETS in the output and phenominal specs, the latest amp from Accuphase, their E-203, comes into the 'affordable' bracket with a retail price set at around $900.

Power output is quoted at 70 W per channel (RMS) into 8 ohms with only .010% THD at rated power from 20 Hz to 20 kHz (both channels driven). Frequency response is within 0.2 dB from 20 Hz to 20 kHz, according to the literature and A-weighted signal to noise ratios are quoted as: 115 dB at rated output (relative to main input), 77 dB at rated output from the moving-magnet input and 70 dB at rated output from the moving-coil input.

The E-203 includes a built-in low-pass filter and output jack for sub-woofer systems. The filter has three selectable cut-off frequencies: 50 Hz, 70 Hz and 100 Hz.

As in the Accuphase E-303 (reviewed in the August '79 issue), this new amp virtually does away with capacitors in the signal path and complementary-symmetry amplifiers are used throughout. Again, selectable turnover frequencies are provided for the tone controls, a subsonic filter and an attenuator switch. A two-step loudness compensation control is also provided.

For more information, contact Arena Distributors at P.O. Box 178, East Victoria Park, W.A. 6101; (09) 361-5422.

Thorens turntable receives rave reviews

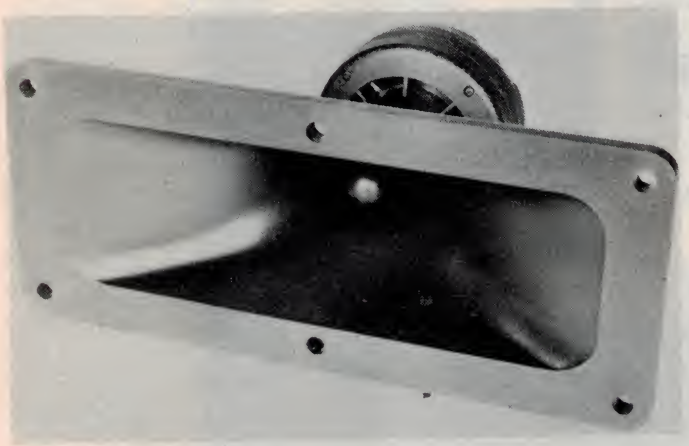
Thorens' new semi-automatic transciption turntable, the TD-115, has received top reviews in the US recently.

The TD-115 uses a dc servomotor as the prime mover and drives the platter through a belt. Sort of a combination of direct-drive and belt-drive. The result is lower rumble, wow and flutter — according to Thorens and the reviews.

The drive motor incorporates a 72-pole tacho-generator for servo control and drives the platter through a special plastic belt. Pitch-control feedback senses the load on the platter and adjusts the motor speed to compensate for heavy loads.

Thorens' "ortho-inertial" suspension is used with the platter and tone arm (TD30) mounted on a sub-chassis that is then suspended from the main assembly body. It seems the idea is to provide different suspension resonances in the two planes of motion and to see that horizontal movement is not transmitted to the vertical plane and vice versa.

Thorens equipment is distributed here by Rank Industries.



Piezo-ceramic tweeters

Melbourne electronics supplier, Edible Electronics, are stocking a range of piezo-ceramic tweeters from Motorola.

This type of tweeter has no magnet and no voice coil — the driving element is a piece of ceramic that moves in sympathy with the waveform of an applied voltage. Motorola claim high efficiency, high output, excellent transient response, low harmonic distortion and good long term stability.

The model KSN 1025A (illustrated here) features a frequency response of 2 kHz to 20 kHz plus/minus 3 dB, according to the spec sheet and measures about 180 mm across the horn mouth (overall) by about 80 mm high and 108 mm deep.

For more information on the Motorola piezo-ceramic tweeters, contact Edible Electronics, P.O. Box 1053, Richmond North Vic. 3121.

Change to CE Show

The 1980 Consumer Electronics Show is to have a change of name and a broadening of scope.

Re-named "Interlect '80", the Hi-Fi industry Association has told the organisers, Riddell Exhibitions, that "anything running off batteries or a three-point plug is fair game . . ." for the 1980 Show.

The exhibition will be staged at the R.A.S. Showgrounds, Sydney, from Wednesday, July 16 to Tuesday, July 22, 1980. Two days will be set aside for trade visitors only.

The Arts and Crafts and AMP Pavilions will be added to the Commemorative and Manufacturers Pavilions for a 13 600 square metre exhibition, 5600 square metres larger than the '79 CE Show, and the largest gathering of electrical/electronic appliances ever seen in Australia.

To facilitate demonstration of hi-fi, the exhibition will be split into two sections with non-sound appliances in the Arts and Crafts and AMP Pavilions, and hi-fi in the remaining area.

The exhibition is sponsored by the Hi-Fidelity Industry Association of Australia, whose members' support of previous CE Shows has been instrumental in the growth of the exhibition since its inception five years ago.

For further information, contact Peter Lucas, Riddell Exhibition Promotions Pty Ltd, 166 Albert Road, South Melbourne, Vic 3205. (03) 699-1066.

EEI parabolics now in N.Z.

Victorian-based manufacturer of parabolic stylii and cartridges, Elite Electronic Industries, is now represented in New Zealand by well-known audio amp manufacturer Zetka Industries Ltd, 65 Pharazyn St, Lower Hutt, N.Z., phone (4) 66-4193.

GALE LOUDSPEAKERS

The Ultimate Draws a Little Closer

Every year the leading designers of fine sound equipment strive towards producing perfection in high fidelity.

Now "The Ultimate Draws A Little Closer" with remarkable British Gale loudspeakers.

Gale performance is outstanding by even the most critical standards. If you have yet to hear for yourself the amazing performance of Gale speakers, read what the experts have had to say about Gale superiority.

"I would back the GS—401A's to just beat the socks off any other speaker anywhere near this size."
(The Absolute Sound, Volume 2, No. 8).

"This loudspeaker is certainly amoung the five best loudspeakers available."
(Hi Fi Studio Magazine).

"This is not a cheap speaker—until you look at it on a price/performance basis. Then it starts to look like a bargain." (Vol. 7 No. 6).
(Australian Hi Fi Magazine).

"The Gale GS—401A is one of the first sounding dynamic loudspeakers that we have heard."
(Australian Hi Fi Magazine).
(Vol. 7 No. 6).

Unparalleled 7 Year Warranty.

Gale GS—401A In Black & Chrome.

The New Gale GS—401C Concave Design Speaker.

The new Gale Ultimate Fidelity Recordings are now also available at your Gale Hi Fi dealer.

Brisbane: Stereo Supplies, Audio Laboratories
Townsville: Disco & Stereo Supplies
Gold Coast: Chevron Sound
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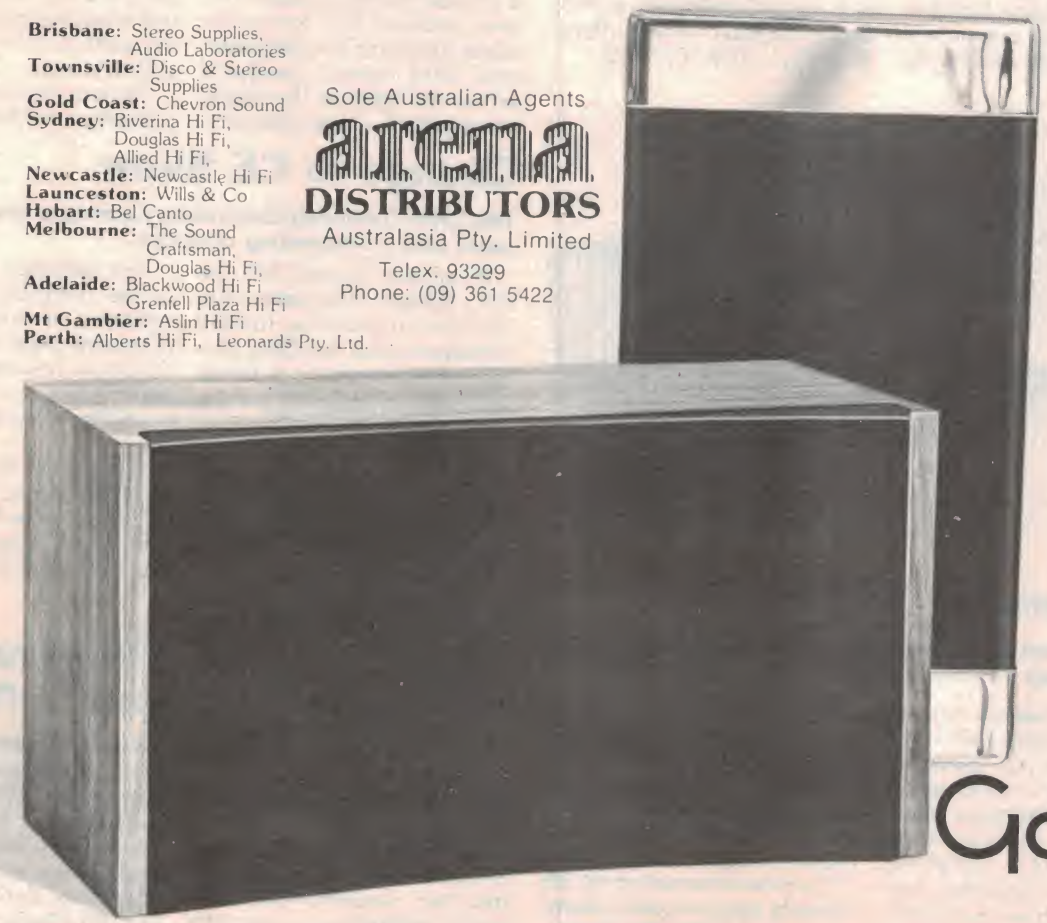

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Principles and problems in loudspeaker design

If you ever wanted to know, in a practical fashion, what is involved in the design of a loudspeaker system, then here's a down-to-earth insight — ending in a real design.

David Tilbrook

MORE MONEY can be saved by the construction of a pair of loudspeakers than any other single component of the hi-fi system. Unfortunately, they are also the most important hi-fi component! Unless the turntable or amplifier is particularly poor, the loudspeaker will undoubtedly determine the overall sound of the system. For this reason it is disappointing there are so few really good kit loudspeakers.

The fact that a "correct" loudspeaker doesn't exist is to be expected, since the principles of loudspeaker operation are enormously complex. Every loudspeaker model makes certain assumptions to simplify the mathematics and to make the model manageable. If these assumptions are overdone the model rapidly loses relevance, becoming incapable of making worthwhile predictions about the *real* loudspeaker. While it is true that a detailed understanding of loudspeaker operation is not necessary to enable a kit loudspeaker to be built, some understanding will enable the optimum to be obtained from the loudspeaker and is essential for those brave experimenters who would like to get involved in modifying the loudspeaker drivers. When designing a loudspeaker it is necessary to understand the mechanism of operation of the drivers. Only then can the best choice of driver, enclosure type and crossover be established. Although loudspeaker design is as much an art as it is a science, the loudspeaker that has been created with a motley assortment of drivers placed in a box with some "general purpose crossover" is more likely to sound like a dropped saucepan than a good loudspeaker!

The most common loudspeaker consists of several moving-coil direct-radiating drivers mounted in an enclosure. These cover different frequency bands within the audio spectrum. A crossover is used to separate these frequency bands and feed them to the appropriate driver.

If the drivers used had perfectly flat frequency responses, were constant eight ohm loads with infinite power handling, and the crossovers represented lossless transfer characteristics with no untoward interactions with the drivers, and if nature did not object to the reproduction of low frequencies in confined volumes (i.e. if the speed of sound was one tenth the speed it is) loudspeaker design would be a simple matter.

Most of these problems can be summarised with one word . . . inertia. This is that property of nature whereby things resist change. We can't really complain too strongly about inertia since it is responsible for much of the order that exists in the universe. Nevertheless, in loudspeaker design it causes real problems. The signal voltage from the power amp, the magnetic field

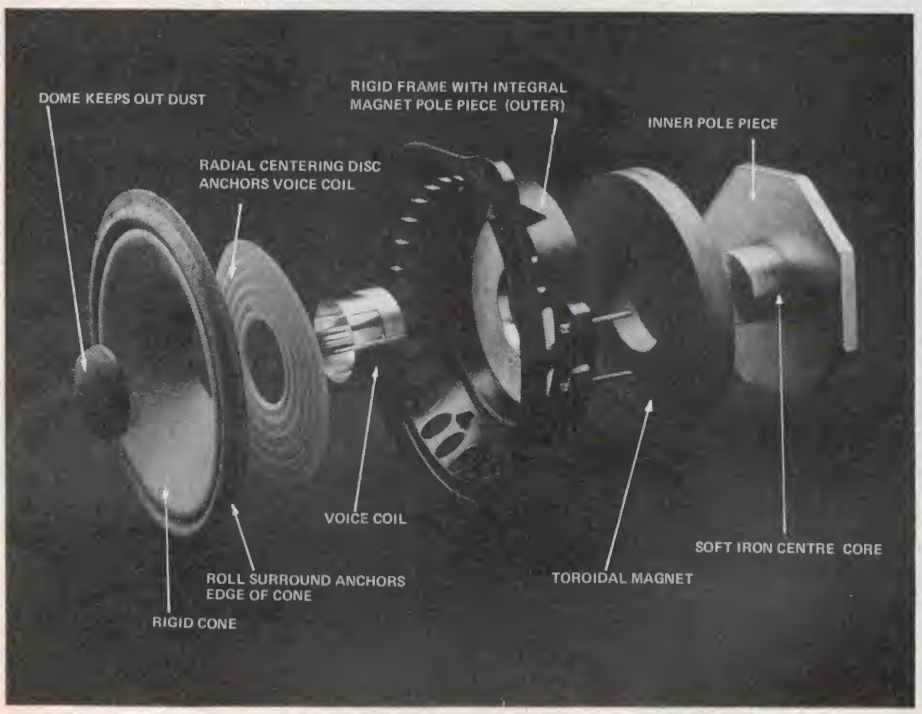
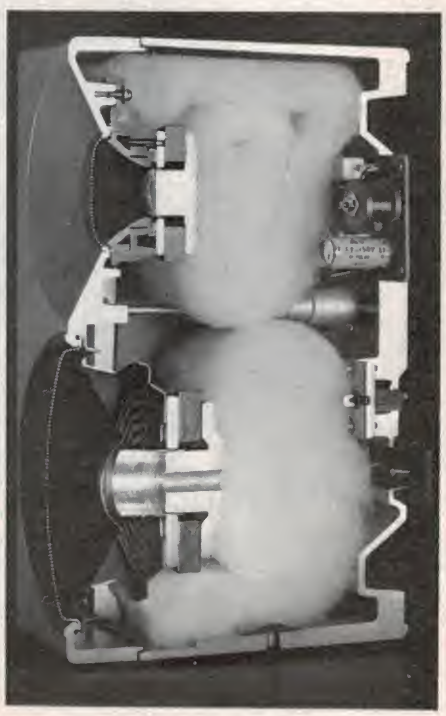


Figure 1. **An exploded view of a moving-coil loudspeaker showing the various components in its construction. Compare this with the cutaway view of a speaker at right (Pic: courtesy Bose).**



Cutaway view of a speaker unit showing internal construction (Pic: National).

around the voice coil, the movement of the coil and loudspeaker cone, all resist change. Since the objective of loudspeaker design is to convert an electrical signal into its exact acoustic counterpart, these sources of inertia cause errors resulting in distortion. The effects of inertia don't stop at just slowing down the system. The resistance to change of motion by the cone for example results in some parts of the cone moving before others. Sound waves start to travel along the cone itself, travelling radially out from the voice coil. Depending on the nature of the flexible surround between the cone and the chassis this sound wave will be partially reflected back down the cone. This causes constructive and destructive interference with the original sound wave propagating up the cone resulting in colouration. Clearly, this is not something the home constructor can do much about, since it depends on the manufacture of the particular driver concerned, but it indicates the sorts of problems that will be encountered.

The moving-coil direct-radiating speaker

The vast majority of drivers used in loudspeakers are of the moving coil type and as such all operate in a very similar way. Figure 1 shows a typical moving coil loudspeaker. Signal voltages from the power amp give rise to signal currents that flow through the voice coil. This is simply a coil of wire wound on a hollow circular former. In normal 8 ohm drivers the dc resistance of the voice coil is around 8 ohms, but the driver will only represent this resistance to the power amp at one specific frequency, the actual impedance of the driver varying widely as the frequency is varied (see Figure 2). A given signal voltage level will therefore produce different signal currents for different frequencies. The signal current causes a varying magnetic field to be produced around the voice coil. This field interacts with an intense magnetic field from the drivers' pole piece and magnet assembly causing a force to be exerted on the voice coil and loudspeaker cone.

As the cone moves it will compress or rarify the air immediately in front of it, creating an area of either increased or decreased pressure. These pressure variations comprise a sound wave that travels from the driver to our ears.

The electrical impedance of the driver is caused by several phenomena each one dominating in a specific frequency band. One of the most significant mechanisms is the back EMF (EMF stands for electromotive force, i.e: voltage) of the driver. The movement of the voice coil in the magnetic field acts as a generator causing a current to flow in the voice coil. This current is of opposite polarity to the applied signal current (another natural application of the principle of inertia) causing decreased current flow in the voice coil for a given signal voltage. This is seen by the amplifier as an increase in the drivers' impedance.

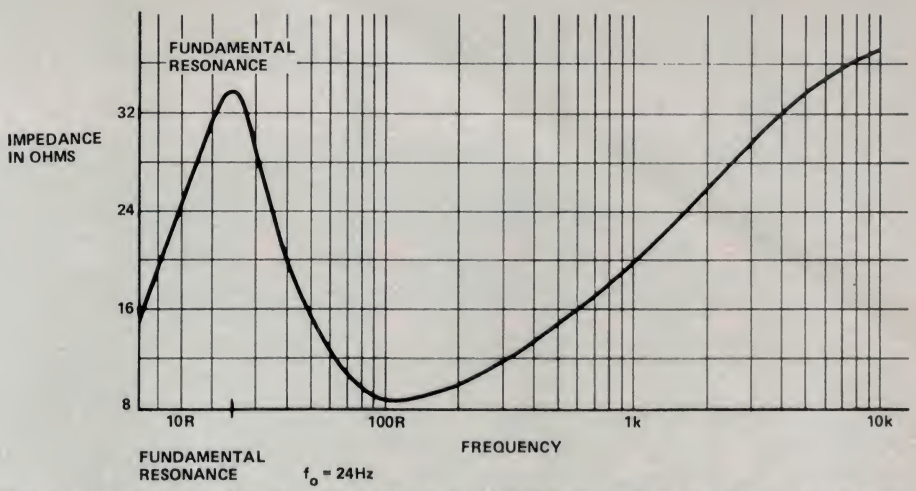


Figure 2. **Typical impedance versus frequency characteristics of a moving-coil loudspeaker**

EMF is given by the simple equation:

EQUATION 1

$e = B1v$

where 'e' is the back EMF in volts
'B' is the magnetic flux
'1' is the length of wire in the magnetic field
and 'v' is the velocity of the cone

Since the magnetic flux and the length of wire in the magnetic field can be considered as constants, the equation shows that the amount of EMF generated is directly proportional to the velocity of the cone.

So the electrical impedance is a secondary phenomenon, is certainly not constant, and does not relate directly to the radiated acoustic power. The amount of back EMF will be determined by the velocity of the cone, and this is a function of nearly every major parameter of the loudspeaker box.

The force exerted by the voice coil on the loudspeaker cone is given by the equation:

EQUATION 2

$F = Bil$

where 'F' = force on the voice coil
'B' = Magnetic field intensity
'i' = current in the voice coil
and '1' = length of wire in the field

Again, regarding 'B' and '1' as constants, the equation shows that it is current and not voltage that determines the force on the voice coil. Since the voltage contains the signal information from the power amp, it would be necessary for a perfectly linear relationship to exist between applied voltage and resulting signal current flow if a distortionless signal is to be produced. The impedance would have to be a constant and this is not the case. Fortunately the movement of the cone is not directly related to the current in the voice coil in the simple way shown above or the frequency response of a loudspeaker would simply be the inverse of its rather lumpy impedance curve.

In order to understand the parameters that determine the acoustic power actually radiated, it is necessary to look at the sources of mechanical rather than electrical impedance.

Converting energy

In the operation of a moving-coil direct-radiating driver there are really two energy conversions going on simultaneously. First the electrical energy is converted into mechanical energy of the voice coil and cone. Secondly this mechanical energy is converted into acoustic energy by the interaction of the cone with the neighbouring air molecules. Both these conversions must be accurate if the final result is to be a low distortion replica of the input voltage waveform.

The laws that apply to mechanical and acoustic forces are directly analogous to those of electrical forces and for this reason we can represent what happens in any acoustic or mechanical problem by a circuit diagram. In mechanics and acoustics there are direct and simple relationships like Ohm's law in electronics. It is only the complex arrangement of mechanical or acoustic circuit elements that makes the picture look complicated.

— to page 131. ▶

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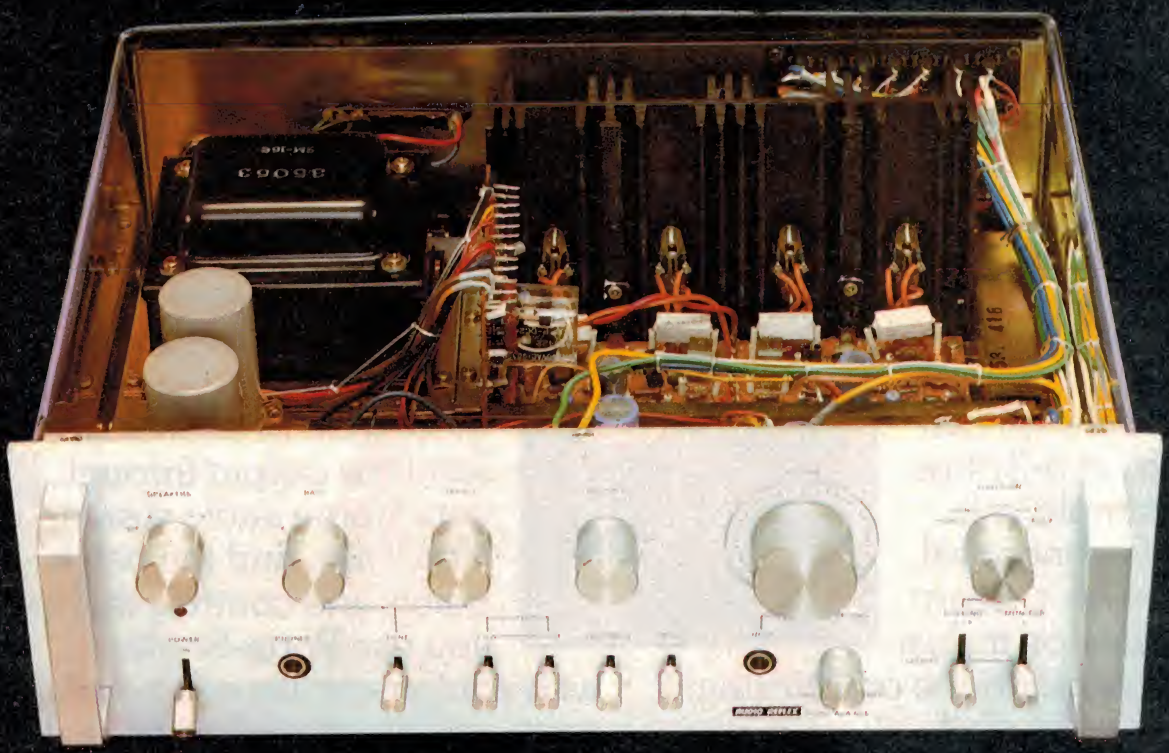

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continued from p. 110

ment parts) or when overdubbing onto selected tracks. The second method, called 'dropping in', demonstrated the amazing flexibility of multitrack recording.

It is sometimes required to overdub a small portion of one track. A few seconds of a particular instrument might be called for and there are just a few seconds of silence on a previously recorded track where it can be squeezed in – or a mistake made in an otherwise flawless take might have to be corrected.

To drop-in on the track all channel switches are set to safe and the recorder is run, in record, to the point where the drop-in is required. At exactly this point the appropriate channel switch is changed to ready, thereby setting that channel only into record mode. At the end of the passage the channel is quickly set back to safe to avoid erasing the following program.

Dropping-in is a very precise and delicate operation, but a skilled, experienced engineer can drop-in on very small segments of the track – as little as one or two notes, depending on the speed and timing of the music.

The other controls of a multitrack recorder – the tape transport functions: play, fast-forward, rewind, pause and stop – are identical with the usual controls. Most multitracks incorporate some form of motion sensing which allows switching transport functions without going through 'stop'. There may also be a cue facility which brings the tape against the reproduce head when the machine is in either of the fast spooling modes, or when editing, so that a specific part of the program can be easily located.

These features are common to all multitrack recorders, from basic four-track to the 32-track monsters. The fully professional machines may be more sophisticated generally, but the basic principle of multitrack recording – the sync-overdub capability – is the same in every case.

The current availability of relatively inexpensive (compared to professional equipment prices) decks with full four-track and sync-overdub capability brings professional recording studio techniques within the reach of the amateur recordist. There is no reason why, with patience and experience, final master tapes suitable for transferring to vinyl could not be produced in a modestly equipped home studio.

Of course a multitrack recorder alone doth not a recording studio make. Other equipment is needed to fully realise the benefits of multitrack recording; monitor amplifiers, speakers, headphones and – most importantly – a mixer (mixing desk or console).

However, the multitrack recorder is the heart of the studio: without it nothing is possible; with a multitrack . . anyone could become a recording industry mogul! ●

FURTHER READING

Olsen, Harry F.; Music, Physics & Engineering (Dover)

Woran, John M.; The Recording Studio Handbook (Sagamore, N.Y. 1976)

Anderton, Craig; Home Recording for Musicians (Guitar Player Publications)

**with thanks to TEAC Aust who provided much of the material from which this article was prepared.*

Elac turntable

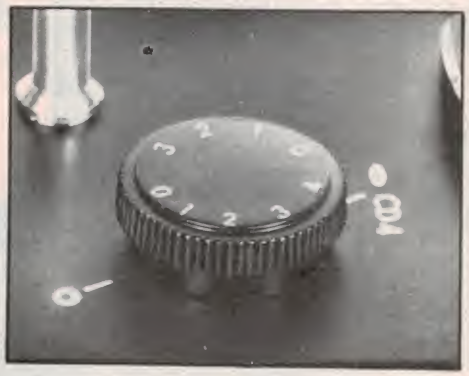
ELAC IS ONE of the best known manufacturers of turntables in Europe — in particular for its automatic-play models. Indeed many hi-fi enthusiasts who seek auto operation will consider only Elac.
The company is also very well known for its range of top quality stereo cartridges (on which Elac hold many of the original patents). Needless to say many of Elac's cartridge products have been specifically designed for use with auto-changer turntables.
The Elac agency has fairly recently been taken over by Atram Electronics — who also handle such well known names as Uher, Hebel and Isophon.
Atram are anxious to make it as widely known as possible that they now distribute these fine turntables and cartridges — and to help do so they are currently offering our readers a hitherto unprecedented opportunity to purchase them at huge discounts — a spare stylus is thrown in as well. Atram Electronics will back up all units with a full six months warranty for parts and labour.

The inital offer is limited to a total of 100 units — if demand exceeds this, Atram will arrange further supplies — but there could be a delay of a few weeks.
In any case please allow at least three to four weeks for delivery.

PC810 $139 (Retail Price $250)

The ELAC PC 810 exceeds hi-fi standard DIN 45 500 in all respects. It is a manual and/or fully automatic turntable with record repeater plus automatic changer mechanism. The unit is supplied complete with lid and STS 155-17 ELAC stereo magnetic cartridge, wired as standard for use with mono, stereo or CD-4 four channel systems. The turntable is driven by a four-pole asynchronous motor and is switchable to either 45 or 33 rpm. A fine pitch control is an invaluable feature for those who need to play an instrument along with the recording. The pick-up arm is tubular and is fully balanced in all planes. Stylus force is adjustable from 1-4 grams. Anti-skating bias compensation is provided for both stereo and four channel cartridges. Standard features include — Arm lift: Push button controls: Freewheeling spindle: Automatic end-of-play switch.

The cartridge insert of the ELAC 810 is fitted with the ELAC STS 155-17 high-quality Hi-Fi stereo magnetic cartridge as standard equipment.



The anti-skating bias compensator permits separate anti-skating adjustment for styli with conical or biradial tip and those with special CD-4 form.

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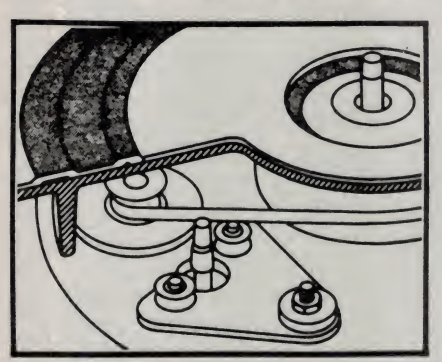

In essence the 830 may be seen as a belt-drive unit but with an idler wheel drive which automatically aids the drive belt whilst running up to speed and also during the inward and outward movement of the pick-up arm. In addition the mechanism ensures that the drive belt is slackened off whenever the turntable is switched off thus preventing belt stretching unevenly. The result of all this is extraordinary smoothness reflected in a wow and flutter figure of 0.08 percent. Rumble is down to 44 dB and signal noise 64 dB.
Naturally the unit operates in both manual and fully automatic modes and has a record repeater plus auto changer mechanism.
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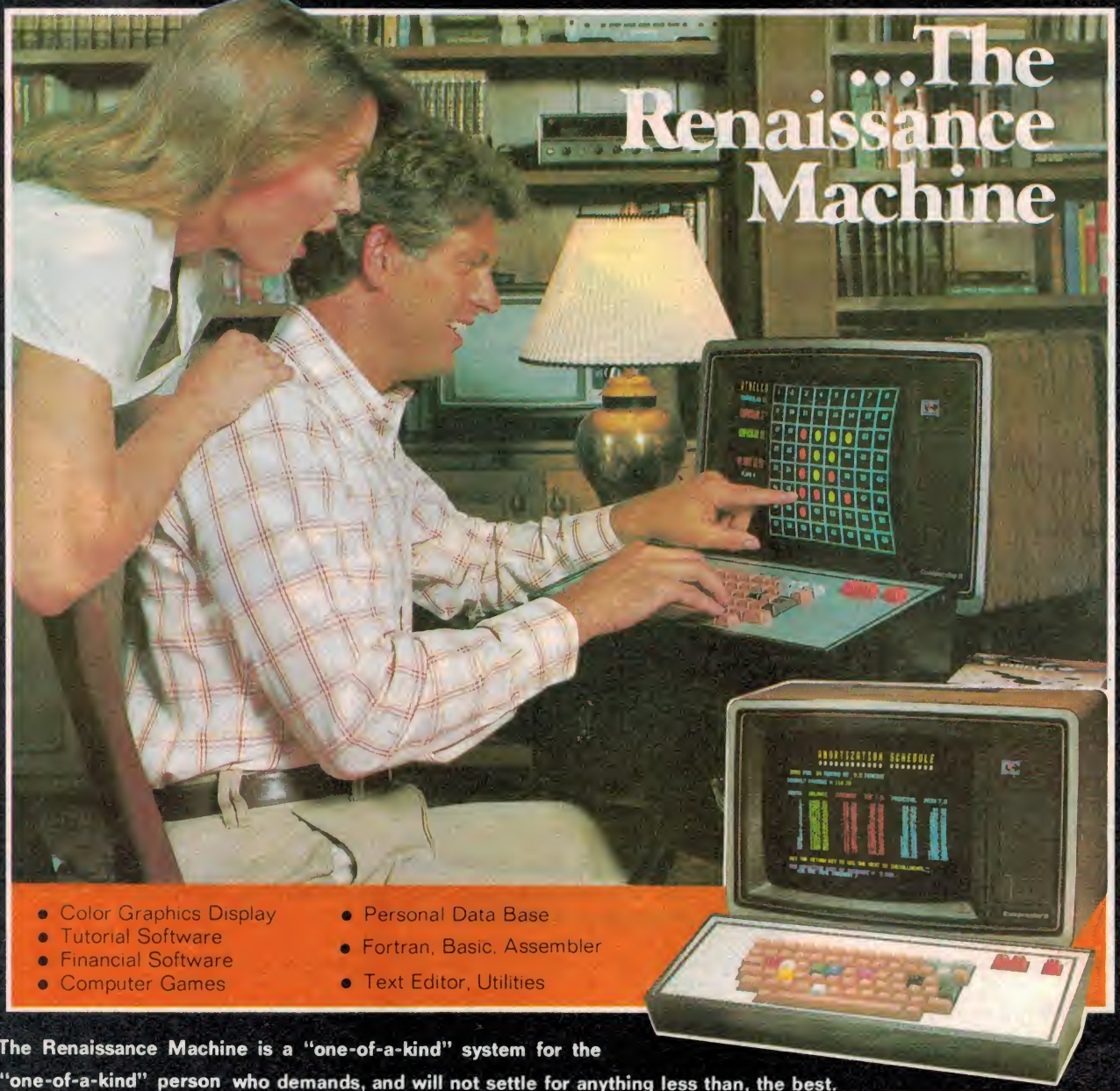

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– from page 123.

FIGURE 3A

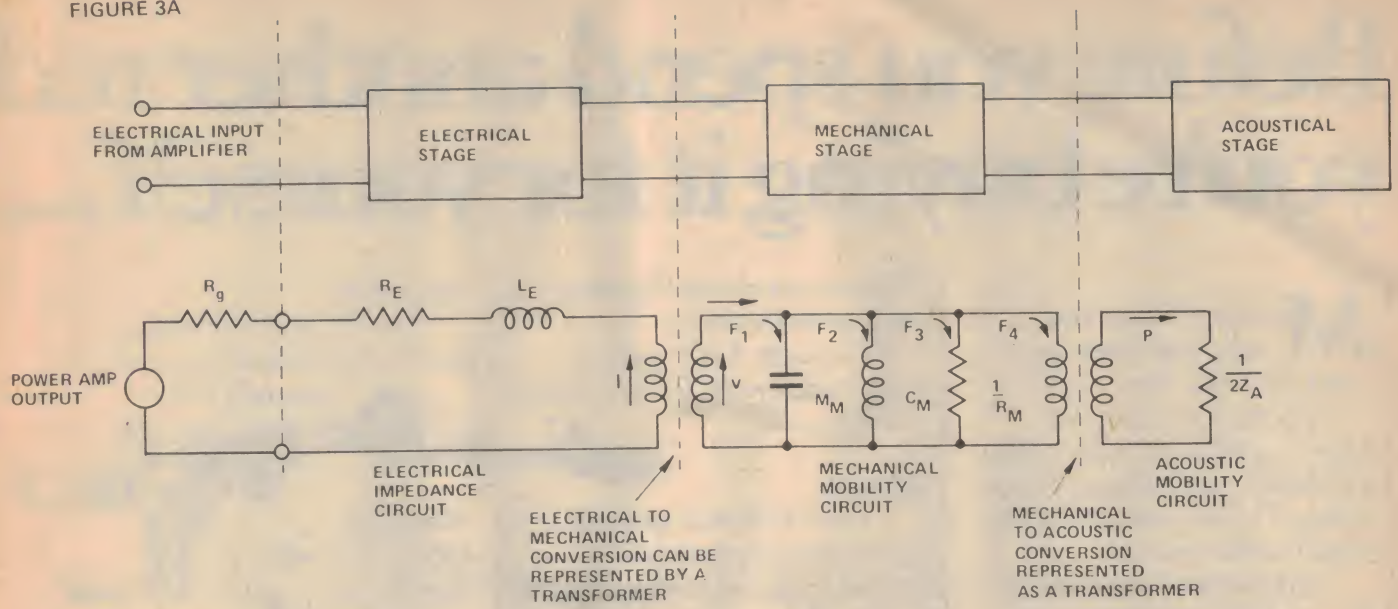

FIGURE 3B

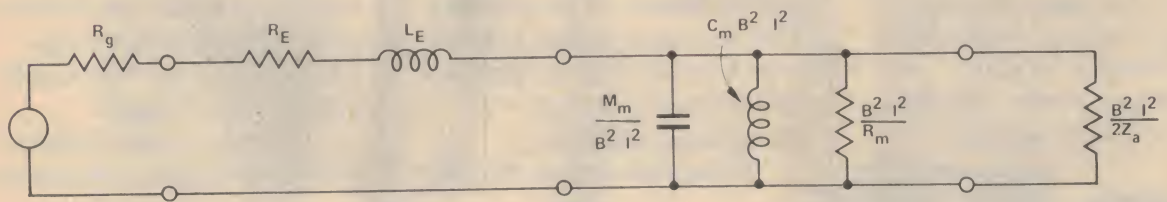

Figure 3. **Equivalent circuit for a typical moving-coil direct-radiating driver mounted in an infinite baffle.**

Just as an electronic circuit can look complex, but can be broken down into smaller and simpler circuits, so too can any acoustic or mechanical problem.

We can represent a complete picture of a dynamic loudspeaker by a circuit diagram showing electrical/mechanical and mechanical/acoustic conversions (see Figure 3a).

The power amplifier is connected via a net series resistance Rg, to the terminals of the loudspeakers. This resistance is the result of the internal resistance of the power amplifier and connecting cables. Since the voice coil is a coil of wire it possesses both inductance and resistance. The applied electrical signal sees these two in series and we represent this by the resistance R_E and the inductance L_E. The "E" simply implies that these are electrical quantities. Current flowing in the voice coil gives rise to the magnetic field that causes mechanical movement of the voice coil and cone assembly. This conversion of electrical to mechanical energy is represented in the circuit diagram as a transformer. Voltage across the primary is represented by the letter "e" and gives rise to velocity 'v', of the voice coil and cone assembly at the secondary of the transformer.

The total force applied by the voice coil ("F") is shown in the mechanical stage as "flowing" through the "wires" just as current would flow through the wires of an electrical circuit. This force sees three mechanical components in parallel, a mechanical capacitance M_M, a mechanical inductance C_M and a mechanical resistance, $1/R_M$. The mechanical capacitance M_M is caused by the mass of the cone. As frequency rises inertia comes into play and it becomes increasingly difficult for the cone to follow the input voltage waveform. The mass of the cone causes a frequency response roll-off at higher frequencies. This could be represented either by an inductance in series or a capacitance in parallel with the load. In Figure 3 this has been shown as the parallel capacitance, M_M.

A loudspeaker cone has a certain springiness, due to the nature of the cone's suspension and the overall construction of the particular driver. We specifiy this springiness by a spring constant, which is simply a number, represented by the letter 'k'. In loudspeaker technology we more often use the term compliance rather than spring constant. Compliance C_M, is defined as:

$C_M = \frac{1}{k}$ where 'k' is the spring constant.

The compliance impedes large movement of the cone. Since bass frequencies require longer cone excursions the compliance of the driver causes a frequency response that falls as frequency decreases. This can be represented as a capacitance in series or an inductance in parallel with the load. In Figure 3 the compliance C_M is represented as an inductor in parallel with the load.

The remaining term in the mechanical part of the loudspeaker circuit diagram is the mechanical resistance. Just as all circuit elements in an electronic circuit have resistance, so to does the mechanical circuit. The resistance is seen in series with the whole mechanical circuit and could be represented as a series resistor or a parallel inverse resistance. If R_M is the mechanical resistance of the circuit, an inverse resistance is defined as:

$$\frac{1}{R_M}$$

In Figure 3a force is shown as 'flowing' in the mechanical 'wires'. The total available force is shared into four major ▶

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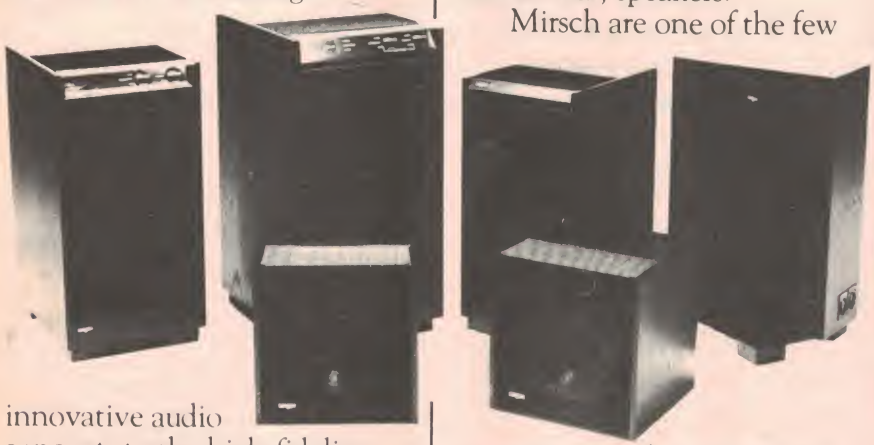

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Dr. Tominari has no qualms about charging generously for the products of his particular brand of genius. Dynavector produce the world's best tone arms. Their design is exceptionally sophisticated. And their engineering near perfect. They are also very costly.

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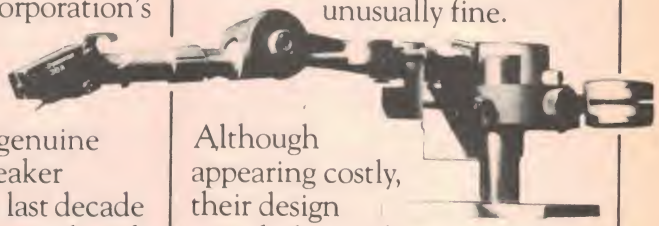

Although appearing costly, their design is such that in the main they need no step-up transformer to achieve their performance heights. As such they can be considered a bargain.

Concept Audio represent Dynavector here in Australia.

Permostat.

Anyone who has ever done physics has seen the effect of rubbing fur on a glass rod. The rod becomes electrostatically charged. And will attract, like a magnet, iron filings, bits of paper and dust.

Recently the people who run lotto in W.A. found static electricity was stopping those vital little numbered balls from tumbling out correctly. Then someone had a brainwave. "Spray the tunnel with Permostat," they said. They did. And it worked.

Patented world wide, Permostat is a unique anti-static spray that renders record surfaces free of dust.

cent on Hi-fi, decide whether or the people down the street.

Research scientist Leonard Feldman states, "Permostat will preserve the life of any record without loss of sound acuity."

Permostat is brought to Australia by Concept Audio.

Hafler

For nearly twenty years American sound purist, David

Hafler manufactured under the Dynaco label. He's now changed direction. A year ago David Hafler began producing superb sound electronics.

Normally finicky, "Stereo Review" says of his DH-101, "a preamplifier of perfect electrical performance". "Audio Critic" comments on his DH-200 Power amp "We can think of no greater editorial delight than to be able to recommend a truly superior piece of audio equipment".

David Hafler equipment is, of course, available in Australia through Concept Audio.

Rega.

They invented the steam engine. And were too polite to exploit it. They invented the jet engine. But were reticent about it. They invented the computer. And missed out with that too.

But the British, despite their rectitude, are a remarkable people. From Britain comes the Rega Planar turntable. However, hand-built, it comes somewhat intermittently. And without instructions.

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parts; the forces needed for the mass M_M, the compliance C_M, the mechanical resistance R_M and the load. If we define these four forces as F_1, F_2, F_3 and F_4 respectively, we can say that

F (the total force available) = $F_1+F_2+F_3+F_4$, and this has been shown in the mechanical circuit diagram. We have to represent the series resistance as an inverse resistance, $\frac{1}{R_M}$ and place it in parallel with the load, to illustrate the way it obtains its part of the total available force (F).

In this case the load is the primary of the mechanical/acoustical transformer. Of course this transformer doesn't actually exist. It is merely a way of representing the conversion of mechanical energy to acoustic energy by the interaction of air molecules with the surface of the loudspeaker cone. Mechanical force in the primary of the transformer is converted into sound pressure 'p', in the acoustic circuit.

In Figure 3a it is assumed that the loudspeaker is mounted in an infinite baffle. This is a partition that extends to infinity in all directions, cutting the universe into two halves, with a hole in which the loudspeaker is mounted. This is just a little impractical, but the only important thing is that no sound produced by the back of the speaker cone can interact with the sound from the front.

In order to move air molecules, the cone must do work so the air impedes movement of the cone. This impedance is called the acoustic impedance and is represented in the circuit diagram by Z_A. Since the loudspeaker is mounted in an infinite baffle the acoustic impedance is the same on both sides of the cone and becomes $2Z_A$.

We are now in a position to understand the causes of variations in the electrical impedance and acoustic radiated power. As was shown earlier, the back EMF is one of the dominant forces acting to increase the driver's impedance. It is related to the velocity of the loudspeaker cone as was indicated by Equation 2. If the motion of the cone is impeded, i.e: if the cone is held, the velocity must decrease, causing a decrease in the amount of back EMF. The decreased back EMF will cause a drop in loudspeaker impedance. So an *increase* in mechanical impedance causes a *decrease* in electrical impedance. With this in mind the electrical/mechanical/acoustic circuit diagram of Figure 3a can be converted into the all electrical circuit diagram of Figure 3b.

This circuit predicts the impedance characteristics of the driver. A generally increasing impedance with frequency is caused by L_E, while M_M, C_M, and R_M form a damped parallel resonant circuit. We would expect a sharp increase in impedance at one frequency, dropping to the dc resistance of R_E and R_G and then slowly rising as frequency increases. This is exactly the response as shown in Figure 2 which is the measured impedance response of a typical 12 inch (300 mm) woofer. This resonance point is called the fundamental resonance of the driver, and being a function of the compliance of the driver, can be expected to decrease in frequency a little as the driver wears in. This is the reason some loudspeaker experimenters "run in" the driver before measuring resonant frequency.

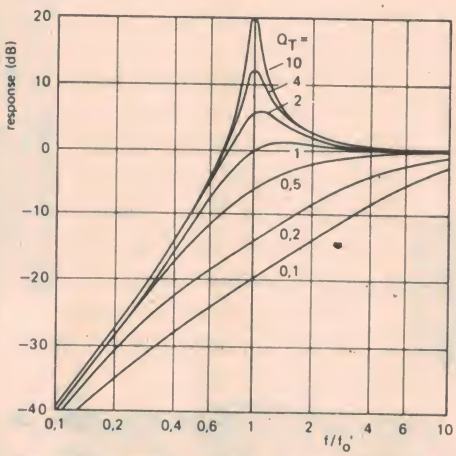


Figure 4. **Normalized frequency response of a typical low frequency loudspeaker for different values of Q_T (after Hermans & Hull, Electronic Applications Bulletin, Vol. 35, No.2., Feb. 1978, Philips).**

A more accurate model

The model of the loudspeaker developed so far has assumed that the shape of the loudspeaker cone remains unchanged and moves as a "rigid piston", following the input signal. This rigid piston theory works well at predicting the characteristics of drivers at low frequencies. At higher frequencies inertia again comes into play and the cone can no longer be considered as a rigid piston. If the driver remained a rigid piston throughout the audio spectrum its frequency response would fall off at a rate of 12 dB/octave at higher frequencies, limiting its useful frequency range.

The equation showing the relationship between the frequency of a sound and its associated wavelength is

$\lambda \nu = V_A$ where V_A is the velocity of sound in air
λ is the wavelength in meters
and ν is the frequency in Hertz.

The equation shows that the wavelength of sound decreases as frequency is increased. It should be noted that the velocity of sound depends on the medium in which the wave is propagating. The velocity of sound in the loudspeaker cone will be substantially different to that in air. Using this equation we can calculate the frequency at which the wavelength of sound approaches the radius of the loudspeaker cone. For a 300 mm (12 inch) loudspeaker this frequency is around 400 Hz and it is at this frequency that the rigid piston theory starts to come unstuck. Above this frequency the sound wave propagates up the cone, hopefully to be damped in the rubber surround. The sound wave is attenuated as it moves through the cone, and this attenuation effect increases with increasing frequency, causing a decrease in the effective cone diameter. This is the effect that enables a single cone loudspeaker to operate over a wide frequency range, since the decreasing effective cone diameter decreases the inertia presented to the coil assembly at higher frequencies. It should be noted that, in this range of the frequency spectrum, the rim and the cone will be radiating in anti-phase with the coil assembly. The way the cone material and suspension react to this multiple wave propagation is one of the biggest differences between a good driver and a poor one. It is for this reason that metal cones for instance are so often unsuccessful. Their ability to damp multiple resonances is generally poor in comparison to materials like paper or plastics.

Damping and Q-factor

In midranges and tweeters the drivers can be operated in frequency ranges that exclude their fundamental resonances. The crossover points are usually chosen so that at least one full octave exists between the crossover point and the fundamental resonance. In the case of bass drivers however it is necessary to operate the driver at and below the resonance of the woofer.

This is the main reason so many different bass loading principles have been developed. The fundamental resonance of the bass driver must be damped so that an acceptably flat frequency response can be established. If the resonance is not damped adequately, the all too common 'one note bass' sound results. This is a particularly noticeable and fatiguing loudspeaker fault and considerable effort must be spent on obtaining a smooth bass end response.

Since the loudspeaker is a resonant circuit the amount of damping can be specified by quoting the Q or quality factor. Q is defined by:

$$Q = \frac{f_o}{f_1 - f_2}$$

where f_o is the frequency of the fundamental resonance. and f_1, f_2 are the 3 dB points.

Figure 4 shows a graph of bass-end frequency responses at a variety of Qs. Although the flattest response appears to be given by the case when the Q=1, this is not the optimally damped case and some boomy bass often occurs in bass systems with Qs around unity. The best Q is probably about 0.5. The bass is not boomy but is also not over-restricted which can happen if the Q drops to around 0.2 or 0.3. The best damping for any specific case needs to be established by experiment and ultimately, as always, the ear must be the final test.

Loudspeaker compliance, the total mass of the cone and the net series resistance with the voice coil, all determine the response of any loudspeaker system and any or all of these can be adjusted in order to achieve the optimum damping and frequency response. In practice, adjustments to the Q of the system are done by modifying the compliance and acoustic mass and resistances caused by the loudspeaker enclosure rather than modification of the driver itself.

The enclosure

The circuit in Figure 3 has been developed assuming that the driver is mounted in an infinite baffle. The air load on the cone of the loudspeaker is represented by an impedance of value:

$$\frac{1}{2Z_A}$$

When the driver is mounted in a practical loudspeaker enclosure, this acoustic impedance becomes a little more complicated and the circuit in Figure 5 replaces the simple resistor of Figure 3. This new impedance is made up of two major components. The radiation impedance from the front of the box (M_{AR}, R_{AR}) is related to the size of the baffle and is independent of the volume of the box.

The volume of air that the driver has access to is related to the effective radiating area of the cone and to the size of the baffle. Since bass frequencies have a greater dispersion than higher frequencies the volume of air accepting the radiated sound increases at lower frequencies. So the impedance on the front of the cone will be greatest at higher frequencies. If the size of the baffle is large in comparison to the radiating size of the driver the box approximates an infinite baffle down to a lower frequency than it would otherwise, and the frequency at which the driver has access to a 360° radiation pattern is decreased. This is represented by the series combination of the inductance M_{AR} and R_{AR}, which gives an impedance characteristic that increases with frequency like the front radiation.

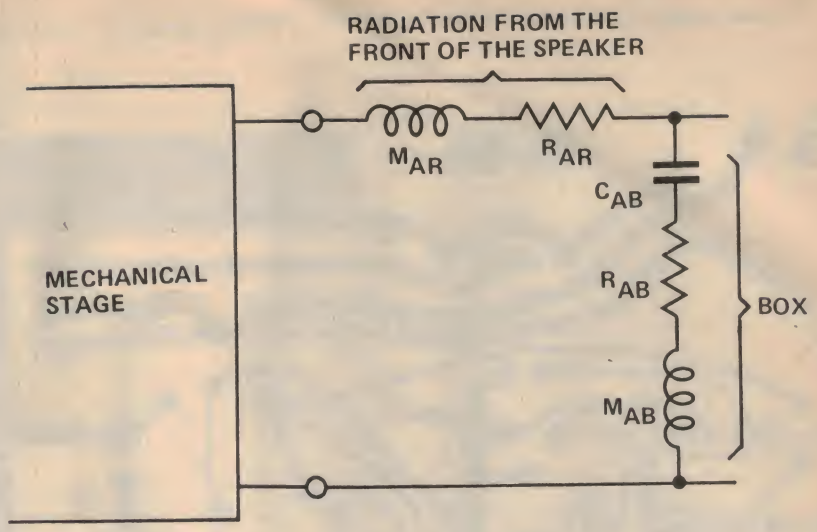


Figure 5. **Equivalent circuit diagram for the acoustic stage of a direct-radiating moving-coil driver mounted in a sealed enclosure.**

The second component of the radiation impedance is caused by the enclosed volume of air within the box. If we consider a sealed enclosure the volume of air within the box will be compressed by the driver. So the enclosure volume will affect the overall compliance of the loudspeaker system. This acoustic compliance is represented in Figure 5 by the capacitance C_{AB}. The effect of this is to increase the stiffness of the loudspeaker cone resulting in an increase in the fundamental resonance of the enclosure.

The volume of air in the box will also have an equivalent mass represented by the inductance M_{AB}. This mass will also affect the resonance of the system by increasing the overall mass of the cone. The acoustic resistance with the enclosure is shown in Figure 5 as R_{AB}.

The final resonant frequency of the driver in the box is a function of the total effect of all the compliances and masses in the system. If the total mass is represented by M_a and the total effect of the compliances is C_a then the resonant frequency of the system will be given by the equation

$$f_o = \frac{1}{2\pi\sqrt{M_a C_a}}$$

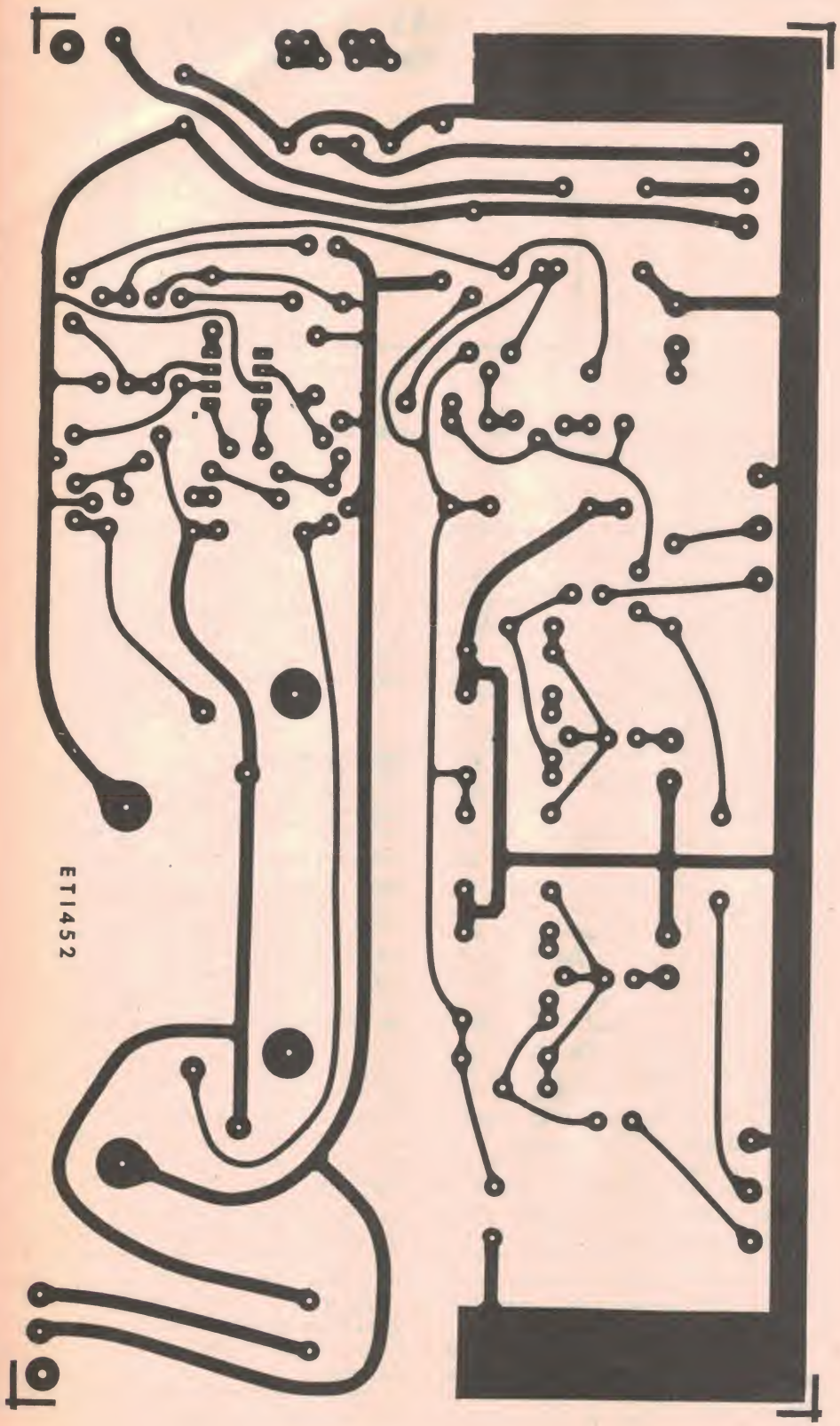
The equation shows that a decrease in either the total mass or compliance will cause an increase in the resonant frequency of the loudspeaker system.

Resonances

The acoustic circuit in Figure 5 represents the reactances caused by the enclosure around the resonant frequency, but as usual in loudspeaker science things get more complicated as frequency increases. As the wavelength of the sound wave produced inside the enclosure becomes shorter the box no longer acts as a simple spring. The produced wave travels from the back of the driver towards the rear and sides of the cabinet, where it is reflected back towards the driver. This sound wave will interact with the cone, either reinforcing or impeding the motion of the cone depending on the particular frequency. This results in successive rises and dips in the frequency response and for this reason it is important that this reflected wave is damped as much as possible. In order to absorb this unwanted energy the enclosure is usually lined with an absorptive material such as bonded mineral wool, acetate fibre or bonded hair felt.

The most important parameter of any of these materials is that they are reasonably open. If the material is too dense it will not only have little absorption but it will decrease the total available volume within the box. ▶

Printed circuit board artwork for the Guitar Practice Amplifier (page 47).



Generally a layer of 25 mm speaker innerbond on the back, sides, top and bottom is about right.

Lining the box also has the effect of altering the acoustic resistance on the back of the cone. This effect is often used to increase the damping and thereby decrease the Q of the system resonance. Usually the necessary damping can be only partially achieved and it is necessary to partially fill the box with an absorptive material as well. If the enclosure is completely filled sound waves within the enclosure are converted into heat in the filler material. Normally this overdamps the box resulting in a Q sometimes as low as 0.1.

Filling the box has one other major effect. Owing to the heating of the material inside the box and its different density to that of air, the velocity of sound within the enclosure is reduced dramatically. The speed of sound in air is around 344 m/s and this could drop to as low as 292 m/s. This has the effect of increasing the compliance of the enclosure and thereby decreasing resonant frequency in the same way as increasing the box volume would. An optimally filled box could appear some 30% to 40% bigger than it really is.

Throughout this article we have discussed the sealed enclosure, leaving explanations of other bass loading techniques to a later time. One of the most common enclosures is the bass reflex, which uses a port cut in the baffle to augment the bass radiation of the driver. The acoustic circuit diagram must show the effects of the mass, compliance and resistance of the port in addition to those shown for the rest of the box, making the loudspeaker equivalent circuit even more complicated. Both the bass reflex and the sealed enclosure are capable of very good results and it is not possible to state simply which is better. We have omitted a detailed discussion of the principles of the bass reflex loudspeaker simply for the sake of simplicity.

Next month we will deal with the problems of mating a collection of drivers to form a completed loudspeaker — another project in our 'Series 4000' line-up of hi-fi components.

Don't miss it!

References

Hi-Fi speaker systems; D. Hermans and M.D. Hull, Phillips applications bulletin 35/1 and 35/2.

Vibration and sound radiation of loudspeaker diaphrams; A.J.M. Kaizer.

Loudspeakers in vented boxes: A.N. Thiele.

For your records, it's A-1.

Want to hear everything on your records?

Don't just boost the volume: cut the distortion.

Our new A-1 amplifier cuts it to less than 0.008%. Your music's going to sound as it did in the studio.

Press the exposed control marked DISC. You eliminate tone and filter control circuitry. It makes the difference between 0.02% distortion and 0.008%.

Another cut on the A-1 is clutter. Only essentials are exposed. Controls such as the built-in MC head amp are hidden, under a drop down front panel.

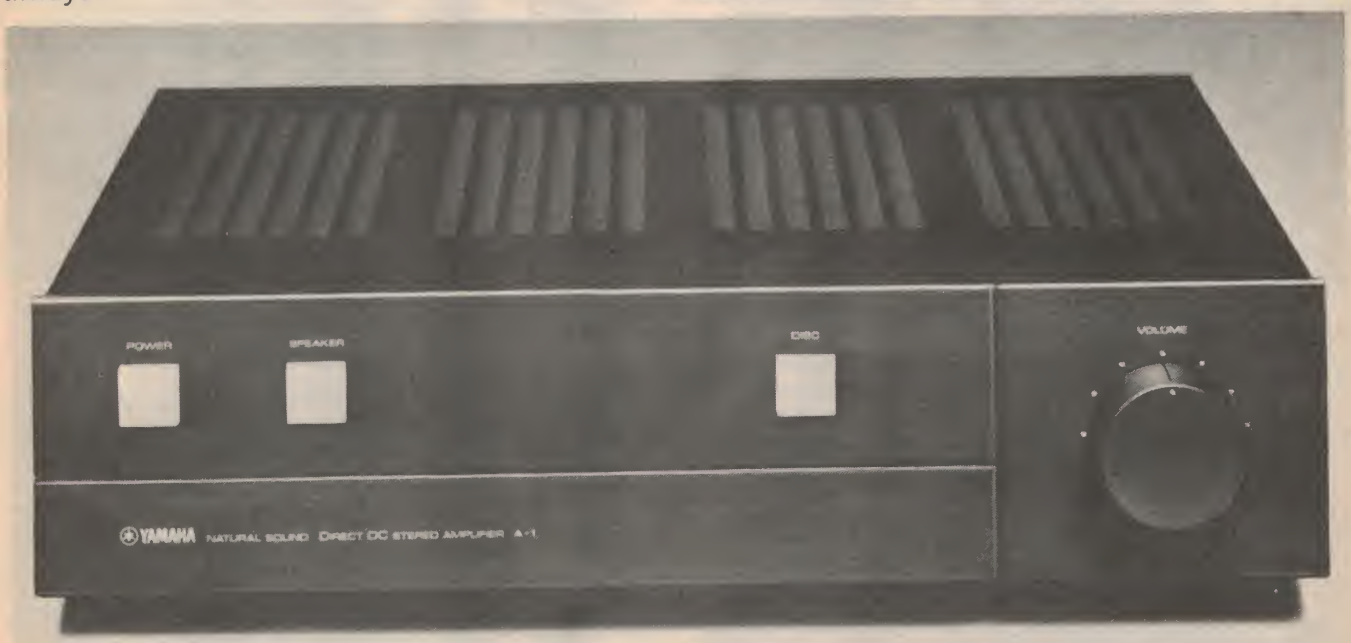
When you do feel like boosting the volume, there's up to 70W per channel in reserve.

Take a favourite record to your Yamaha dealer. Listen to your first A-1 experience.

You'll want your records to sound like that, always.

YAMAHA A-1 DC direct coupled amplifier
Minimum Output Power: 20-20,000 Hz 70 + 70 watts
Total Harmonic Distortion: less than 0.005%
IM Distortion: less than 0.003%
Phono S/N Ratio: over 85 dB
Phono MC S/N Ratio: better than 70 dB
Residual Noise (DISC ON) less than 50 uV,
Frequency response (RIAA) 20 Hz 20 kHz 0 ± 0.2 dB
Tune to SP out: 20 Hz to 20 kHz + 0,-02 dB
Power consumption 215W
Dimensions (WxHxD) 435 x 117 x 381mm 17⅛" x 4⅝" x 15"
Weight 15.8 kg (34 lbs 12 oz.)

YAMAHA MusicLand



N.S.W. Sydney. Leisure Sound, Sydney–Park HiFi, Sydney–Leisure Sound, Artarmon–Russin Electronics, Ashfield–Allied HiFi, Crows Nest–Audiocom Stereo HiFi Sales, Eastwood–Audiocom Stereo HiFi Sales, North Rocks–Len Wallis Audio, Lane Cove–Warringah HiFi, Mona Vale–Miranda HiFi, Miranda–Miranda HiFi, Parramatta–Miranda HiFi, Roselands–Miranda HiFi, Taren Point–**Country** Newells Music Centre, Armidale–Max Ingersole, Bathurst–Byron Bay TV Sound Centre, Byron Bay–Melody Music, Dubbo–Forster Colour Television, Forster–Greigs Music House, Goulburn–Miranda HiFi Gosford Pty. Ltd., Gosford–Lismore HiFi, Lismore–Music Centre, Murwillumbah–Newcastle HiFi, Newcastle–Melody Village, Port Macquarie–Springwood HiFi, Springwood–HiFi House, Wollongong–Duratone HiFi, Phillip A.C.T.–**VICTORIA** Melbourne. Natsound Pty. Ltd., Melbourne–Radio Parts Group, Melbourne–George Hawthorn Electronics, Armadale–Selim Electronics, Camberwell–Soundair Centre, Caulfield–The Soundcraftsman, Caulfield–Beland Electronics, Cheltenham–Radio Parts Group, East Malvern–Tivoli HiFi Pty. Ltd., Hawthorn–Denman Audio, St. Kilda–**Country** Daryl Smailes Car Radio, Albury–Belmont Stereo Systems, Belmont–Prouds Audio World, Bendigo–Steve Bennett Audio, Geelong–Tattersalls Sound Centre, Shepparton–John Martin Music Studio, Swan Hill–Martin Hill Hi-Fi, Morwell–**TASMANIA** Nine Wilson St. Hi-Fi, Burnie–Downtown HiFi, Devonport–Teak House Pty. Ltd., Hobart–Begent McGuire, Launceston–**QUEENSLAND** Brisbane. Reg Mills Stereo, Brisbane–Stereo FM Centre, Brisbane–Living Sound Centre, Ashgrove–HiFi Sales Kipparing–**Country and Coast** Adcocks Agencies, Ayr–Andersens Music Store, Bundaberg–Warehouse Traders, Cairns–D.J.L. Electronics, Caloundra–The Sound Centre, Coolangatta–GJS Electronics, Gladstone–Buckleys Music Centre, Grafton–Hoopers Music Centre, Gympie–Mackay Audio Centre, Mackay–Keller Electronics, Maryborough–Custom Sound Centre, Nambour–Premier Sound, North Rockhampton–Gold Coast HiFi, Southport–Geoff Bradford HiFi, Toowoomba–**SOUTH AUSTRALIA** Adelaide. Trak 1 HiFi, Adelaide–Sound Dynamics, Adelaide–Blackwood Sound Centre, Blackwood–Revolver HiFi, Goodwood–Blackwood Sound Centre, North Adelaide–Country Music Sales, Berri–Audio Sonics, Gawler–Chessers, Port Lincoln–Harding and Manning Electrical, Whyalla–**NORTHERN TERRITORY** Murray Neck Pty. Ltd., Alice Springs–Pfitzners Music House, Darwin–**WESTERN AUSTRALIA** Perth. Audio Centre Pty. Ltd., West Perth–Audio Distributors, Mosman Park–Western Amplification, Nedlands–Audio Centre Pty. Ltd., Victoria Park–Denham HiFi, Albany–P. F. & J. E. Collins, Bunbury–Park Music, Rockingham–Wickham Sound Lounge, Wickham. Y731

The Nakamichi 480 two-head cassette deck

Little brother to the 680 (see Sept. '79 issue), this machine also features the 'diffused resonance' transport, metal tape facility and 'exemplary' performance.

HAVING REVIEWED the Nakamichi 680 three-head cassette deck in the September '79 issue of ETI we were pleased to review a less expensive Nakamichi machine. The 480 is the down-market version of the 680 and 582 (ETI July '79). The manufacturer's philosophy for this machine is to maintain quality of performance through deletion of various options that cater for the faddist and the person who is looking for the ultimate in frills. The machine does not compromise in quality, but rather in the number of controls.

The front of the deck is very similar to the 582 and features on the left hand side a power on/off switch, a stereo phone socket and a cassette well (which is pneumatically damped on eject), with a three level escutcheon on the right hand side of the cassette well.

The top row of this escutcheon contains a 3 digit counter and two peak reading VU meters (covering the range -40 to +7) which are illuminated when the unit is switched on. The second row contains the eject button for the cassette deck, the counter re-set button and two separate slide controls in a linear array for adjusting the record level for left and right channels respectively. Whilst this provides a neat appearance we do not regard it as a good ergonomic design feature. It is not as convenient nor as efficient as two separate slide controls one above the other or side by side, which allows for adjusting two channels simultaneously.

The bottom row contains electronic touch switch controls for record, rewind, stop, play, fast forward and pause with illuminated bezels being activated by the record, play and pause buttons. The last set of pushbutton controls in the bottom right hand corner is the memory on/off switch which allows the inbuilt memory to return to the zero position when the memory button is switched on and the rewind control is activated.

The other controls are a muliplex in/out switch for recording off FM radio, a Dolby in/out switch, two tape selector switches which are labelled SX (for chromium dioxide or chrome equivalent tapes) EX (for low noise gammaferric oxide tapes) and ZX (for metal alloy tapes). The last control is the equalisation switch with 120 microseconds for gammaferric oxide and 70 microseconds for chrome and metal alloy tapes.

The rear of the cabinet is sparse, featuring two pairs of RCA coaxial sockets for line input and output and a remote control socket for use with the Nakamichi RM100 Remote Control Module.

The inside of the cabinet presents a colourful sight with one large L-shaped printed circuit board containing all the main components with the exception of the transformer, power switch and cassette drive mechanism. This is beautifully labelled with each individual component being clearly identified, making the task of a serviceman delightfully easy. One feature we did not like was the mounting of the fuses on the underside of the board which would necessitate taking off the bottom cover rather than the top cover to replace a fuse in the event of its failure. Nakamichi, like many manufacturers, believe however that if a fuse blows something more serious has happened, and this falls into the domain of "No user serviceable parts inside". The cassette mechanism appears to be very similar to that used in the 582 model and is based on the diffused resonance principle.

Evaluation

The objective testing presented no surprises. The replay frequency response of the unit provided us with an exemplary performance of ±3 dB from 10 Hz to 20 kHz with gammaferric oxide and chrome or chrome equivalent tape and 10 Hz to 15 kHz with metal oxide tape. It should be noted that the performance with the metal oxide tape still extended smoothly to 20 kHz being only 4 dB down at that frequency.

The record to replay frequency response proved to be more interesting in that none of the tapes were able to go beyond 18 kHz although the performance with standard gammaferric oxide, chrome and metal oxide was unusually smooth and quite outstanding. With the low noise gammaferric oxide the performance extended to 14 kHz with Dolby in and 18 kHz with Dolby

out at the -3 dB point, whilst with Sonychrome and TDK metal oxide tape it extended to 18 kHz with a remarkably smooth response. An 18 kHz limit in terms of record to replay does not greatly concern us as there is little or no recorded content beyond that in either live or dubbed material which the normal user would seek to record.

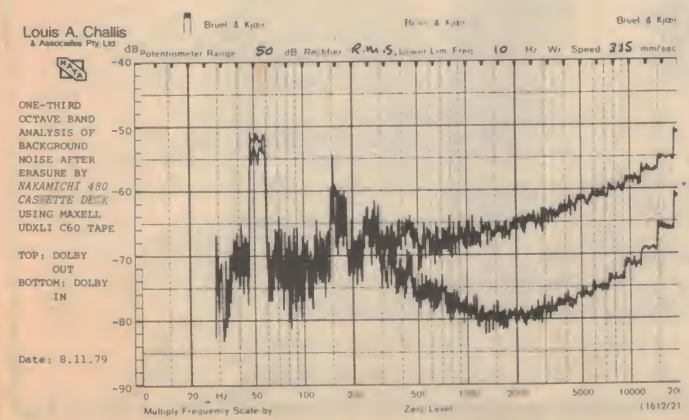
The signal to noise performance of the equipment is dominated by the 50 Hz mains hum component such that the unweighted signal to noise ratio with Dolby out is 45.5 dB and the unweighted signal to noise ratio with Dolby in is -52 dB. The A-weighted figures are substantially better and with Dolby in reach an acceptable level of -62.5 dB (A). (These figures were better than achieved by the Nakamichi 680 cassette recorder). The wow and flutter figures are particularly good and result from the use of the diffused resonance drive mechanism. This achieves a weighted flutter of 0.04% RMS which was better than that achieved by the 680 model.

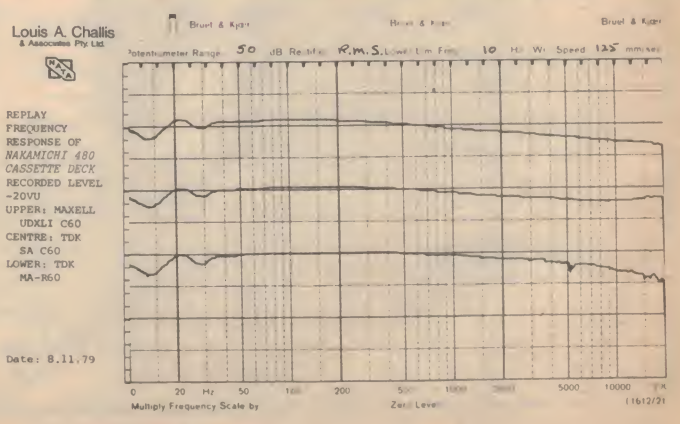
The distortion characteristics are very low and at -6 VU are better than the average listener would ask for. At 0 VU the distortion starts to rise significantly, reading 2.2% at 6.3 kHz because of the saturation of the tape. The maximum input level on the machine for 3% third harmonic distortion is +4 VU on conventional low noise gammaferric oxide tape and the additional 3 dB range on the VU meter would increase the distortion level to a completely unacceptable level.

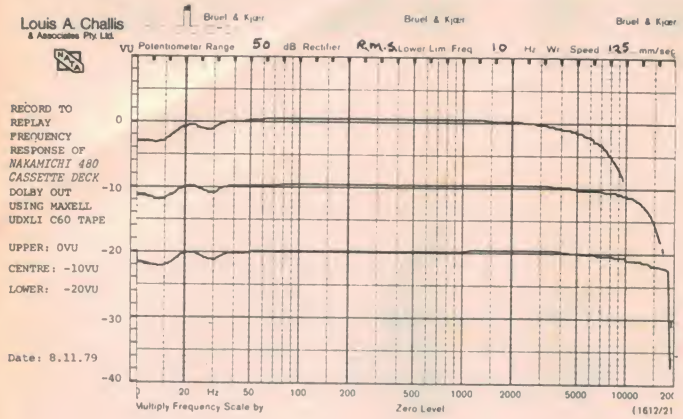
The erasure ratio on Maxell UD XL exceeds 94 dB whilst the erasure ratio of metal oxide tape exceeds 74 dB. These erasure ratios are excellent and completely inaudible.

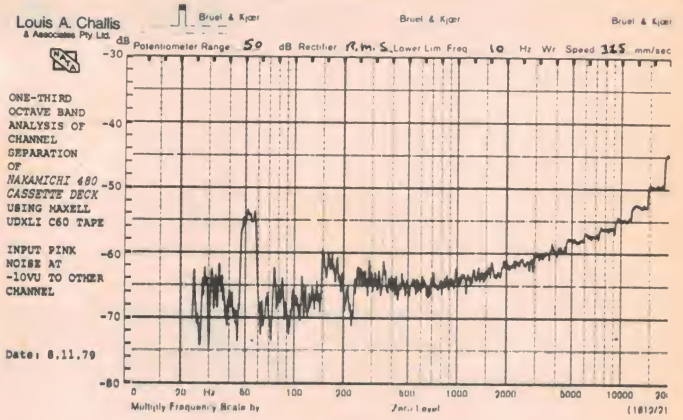
Subjective

The subjective assessment of the machine highlighted a number of interesting factors. Firstly we did not like the record level controls being separated in a single line as opposed to a parallel line. This may be perfectly alright for recording in our laboratory tests, but in normal home use when recording off tape, radio or external microphones (with a separate preamp-▶









lifier unit) this was just not to our liking. The paucity of controls is, however, not a cause for complaint, in that most people do not want the number of facilities that are incorporated in more expensive machines such as the 680. We did not miss the play back level controls as this function should be realistically accommodated by the volume control on the preamplifier unit with which the cassette deck is connected.

The single stop memory control is simple and proved to be adequate for normal listening. The VU meters may not be as flashy as fluoroscan displays but the 40 dB effective viewing range that they provide proved to be more than adequate and also convenient. In keeping with the touch controls that Nakamichi have used over the last ten years, the main function controls were positive and delightful to use. The internal switching logic neatly took care of nasty switching from rewind to play, fast forward or stop without any complications.

Conclusions

The quality of the reproduction was the most outstanding feature and most probably the "piece de resistance" of this deck. Whilst the 680 may cost three times the price, we were unable to subjectively detect any worthwhile advances in performance in that machine when compared to the 480. Given a choice between the 480 and 680, we feel that the 480 offers comparable (and in some areas better) performance at a fraction of the price. Nakamichi cassette recorders are obviously not everybody's cup of tea (because they cost more) but the 480 must come very close to matching the conflicting requirements of price and performance. ●

THE NAKAMICHI 480 2-HEAD CASSETTE DECK

Dimensions: 450 mm wide x 135 mm high x 289 mm deep

Weight: 6.4 kg *Price: $399*

Manufactured by Nakamichi Corporation, Tokyo, Japan.

Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF THE

NAKAMICHI 480 CASSETTE DECK, SERIAL NO. A3045 05886

RECORD TO REPLAY FREQUENCY RESPONSE AT -20VU:

Tape	Dolby	Lower -3dB Point	Max. Point & Frequency	Upper -3dB Point
Maxell UD XLI C60	In	15Hz	0.5dB @ 11.5kHz	14kHz
Sony C-60CR	Out	15Hz	1.0dB @ 10kHz	18kHz
TDK MA-R60	Out	15Hz	3.0dB @ 15kHz	>18kHz

SPEED ACCURACY: 0.15%

WOW AND FLUTTER: Wow: Average 0.1% p-p

Flutter: Unweighted 0.095% RMS
Weighted 0.04% RMS

HARMONIC DISTORTION:

(Utilising Maxell UD XLI C60)

		100Hz	1kHz	6.3kHz
0VU:	2nd	-49.2dB	-	-46.4dB
	3rd	-43.1dB	-43.5dB	-33.2dB
	4th	-	-	-
	5th	-50.6dB	-57.0dB	-
	THD	*0.83%*	*0.68%*	*2.2%*
-6VU:	2nd	-53.7dB	-	-53.7dB
	3rd	-50.3dB	-53.0dB	-40.7dB
	4th	-	-	-
	5th	-54.5dB	-	-
	THD	*0.41%*	*0.22%*	*0.95%*

NOISE:

(re 0VU, utilising Maxell UD XLI C60)

Dolby Out	-45.5dB(Lin)	-51.0dB(A)
Dolby In	-52.0dB(Lin)	-62.5dB(A)

MAXIMUM INPUT LEVEL:

(for 3% third harmonic distortion at 1kHz utilising Maxell UD XLI C60) +4VU

ERASURE RATIO:

(for 1kHz signal recorded at maximum input level, utilising Maxell UD XLI C60) >94dB

DYNAMIC RANGE:

(utilising Maxell UD XLI C60)

Dolby Out	49.5dB(Lin)	55dB(A)
Dolby In	56.0dB(Lin)	66.5dB(A)

The $399* Nakamichi

New Nakamichi 480 metal compatible 2 head cassette deck.

If you know Nakamichi products, you'll know $399* sounds too cheap for real Nakamichi quality. But if you know Nakamichi, the man, you won't be that surprised.

Nakamichi's genius for innovation has created a new Nakamichi range that makes brilliant reproduction at incredibly reasonable prices a reality.

Take the new 480. It is the personification of Professor Nakamichi's latest technology and his policy of producing components with an excellent performance/cost ratio.

Nakamichi 480 can play and record conventional and the new metal tapes and is available with an optional remote control unit. It has a frequency response of 20Hz-20KHz (-20dB Rec. level), wow and flutter less than 0.11 percent WTD peak, 0.06 percent WTD rms, signal to noise ratio (Dolby NR In, 70us) — better than 62dB at 400 Hz, 3 percent THD WTD rms, cross-talk better than 60dB at 1 KHz, OdB, erasure better than 60dB below saturation level at 1 KHz and total harmonic distortion less than 1.0 percent at 400Hz, 0dB (ZX, EXII tapes) and less than 1.2 percent at 400 Hz, 0dB (SX tape).

And if you're not sure about all that technical jargon, it means, quite simply, that the Nakamichi 480 performs brilliantly. But don't take our word for it. Experience the difference Nakamichi technology makes to high fidelity sound reproduction by visting your nearest Nakamichi dealer.

Nakamichi

Products of unusual creativity and competence.

*Recommended retail price

For further information contact:
Convoy International, 4 Dowling Street, Woolloomooloo, NSW. 2011. Phone (02) 358-2088.

The Crown PSA-2 "self-analysing" professional amplifier

Preceeded by a reputation for reliability and performance, Crown amplifiers are well known in professional music production spheres. Their reputation is well deserved, as can be seen from this review.

IN THE BIG LEAGUE, the Crown Amplifiers have had a notable reputation as being among the foremost amplifier designs suitable for professional and to a lesser extent, amateur usage. Most of the large rock shows produced in Australia, America and Europe have utilised Crown amplifiers which have built up a reputation for reliability and performance.

The PSA-2 is the latest of the Crown amplifiers to reach this country and has a number of unusual features. The frontal area of this amplifier has a series of vertical louvre grilles to provide enhanced ventilation; a central section containing a series of red, green and amber light emitting diodes to indicate the operating conditions of the amplifier and two volume controls for the left channel/right channel and power on/off switch.

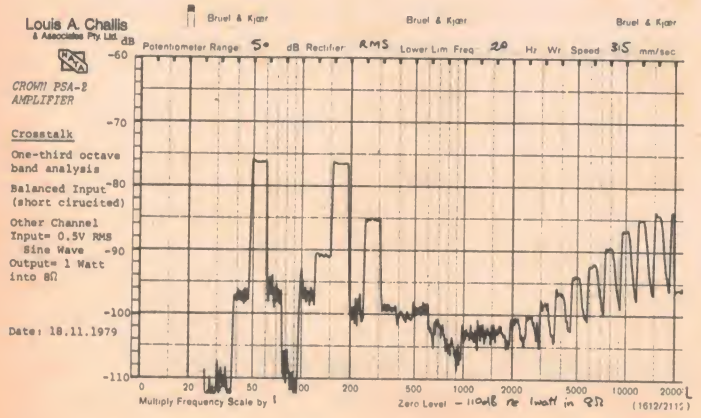
The displays indicate standby mode, the presence of an output signal in either the left or right channel and a set of red lights to indicate overload in either channel. The seventh light indicates that the power is on and it seems almost redundant when the operating functions of the other lights are considered. The rear of the amplifier is far more interesting than the front and features the heaviest mains cord we have ever seen; a self-contained cooling fan thermally activated by load conditions and a plug-in module to provide balanced input capabilities. These feature Cannon type connectors to meet professional requirements and balanced input circuit facilities than an amplifier of this professional class calls for.

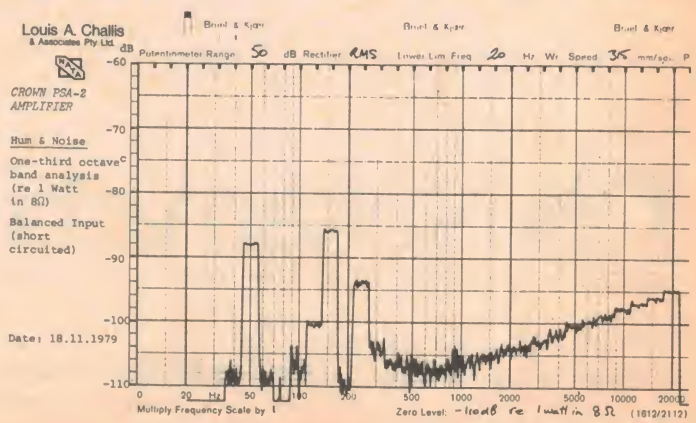
The design

The PSA-2 amplifier balanced input module is particularly interesting. It contains high pass and low pass filter modules based on three-pole Butterworth filters, roll offs of 18 dB per octave. These operate at 50 Hz and 15 kHz respectively when either switch is selected. The unit also contains a built-in compressor which provides 14 dB of compression for use with live shows. This is adjustable from the overload level theshold to 12 dE below that. The unit also contains an internal generator which produces a 50 Hz to 20 kHz wide spectrum for testing the overall performance of the amplifier.

Unlike other amplifiers this unit is intentionally designed for single-ended push-pull driving. Under these conditions both component amplifiers can be set in the mode with each of them being 180° out of phase to the other. The amplifier then functions into a single load as a single amplifier in situations calling for the maximum power drive into a single load. To simplify the task, the output sockets are arranged in a square block so that the plugs on the standard 20 mm spacing can be either pushed into the individual channels or alternatively the two active terminals of each of the amplifier sections when used in the single amplifier mode. The unit contains a switch on the back panel to select this mode of operation without the fuss and bother of checking connectors and incorporating a phasing transformer.

The inputs to the amplifier are either single-ended tip-and-sleeve or balanced Cannon type sockets. The amplifier incorporates self-protection against power overloads and output short-circuiting. It is robustly constructed in a steel chassis with a solidly constructed





perforated steel lid to provide combined ventilation and protection.

The primary output stage of the amplifier uses complementary symmetry Class A/B stages having circuitry which is significantly different from previous Crown amplifiers. The most important difference is the method of supplying positive current from the positive output stage and negative current to the negative output stage by means of two high voltage supplies. The common point between the two output stages is ground.

The unit also departs from previous Crown Amplifiers in that the overload protection circuit takes the signal from the output stages referenced to ground and feeds these back to the balanced input stages to reduce their drive level, and thereby protect the output stage. The internal logic also provides current protection and thermal protection for the unit. When the protection circuit logic detects an anomaly it removes power from the Vcc supplies and this protection cycles the amplifier from standby mode to operate normally, depending on the nature of the problem.

The high voltage transformer windings also provide a logic current signal when excessive currents are drawn and a further section of the logic switches on the cooling fan when the internal temperature exceeds 47°C.

On test

The objective testing of this amplifier was, in the main, relatively straight forward. With an unbalanced input, the amplifier provides a dc to 73 kHz bandwidth, whilst with a balanced input this changes to 2.6 Hz to 53 kHz bandwidth.

The sensitivities of 42 mV for the unbalanced input and 10 mV for the balanced input, providing 1 watt into 8 ohms, are adequate for almost any professional application and quite a few amateur ones as well. The input impedances of 20k for the direct and 10k for balanced input are also in keeping with what most professionals would want. The output impedance is less than 50 milli-ohms at 1 kHz and in most professional situations the real output loading would be determined by the cabling rather than the amplifier.

The harmonic distortion of this amplifier is relatively low and tends to be dominated by the second harmonic at all frequencies. The distortion measured with direct versus balanced input, is superior with the balanced input at low frequencies but is markedly better with the unbalanced input at high frequencies.

The harmonic distortion characteristics are superior to what most professional applications would call for, both at rated power (both channels driven) or even at 1 watt output. There is not a lot to separate the distortion characteristics at 1 watt and 200 watts and although these figures are not the lowest we have seen, they are most certainly amongst the lowest.

Our standard transient intermodulation distortion test could not be performed effectively because of the operation of the internal protection circuit. At lower levels the transient intermodulation distortion figures were quite exemplary. The signal-to-noise ratio and hum levels of the unit were also exemplary and considering the size of the unit, amongst the best that we have seen. The maximum output power is voltage limited and because of the self-protecting circuitry, limits the ability to examine, or artificially produce, power levels which are dangerous.

The protection circuit is inaccessible and as we subsequently discovered in the event of something going wrong you have to remove the cover to get access to the last line of defence which in this case is provided by fuses. The self-analysing characteristics of the amplifier make it a little harder to test than many of its competitors. Firstly, when trying to perform overload tests the unit automatically switches in attenuation near the input stage. This avoids the catastrophic problems of the type which are the rule rather than the exception with professional amplifiers. For this reason, we had to resort to a series of unusual ploys in order to determine how well the amplifier would withstand heavy professional use.

The first of these was to set the amplifier up with single ended push-pull drive connections with an output power of 700 watts into an 8 ohm load. After one and a half hours with this signal an internal fuse blew without the normal protection circuit being activated. By this time the large power resistors in our load were beginning to glow cherry red! After the fuse was replaced the testing continued without a hitch.

Subjectively

To use the full subjective characteristics of this amplifier requires a set of speakers substantially larger than those which we have available in the laboratory. Even in our listening room with all our speakers in parallel we would be hard pressed to provide a load commensurate with the capabilities of this amplifier.

Instead of trying to evaluate its high power capability subjectively, we connected up two sets of speakers in parallel (with a load impedance characteristic of 8 ohms or greater) in order to see how it performed. With an unbalanced input to each channel and just the low frequency filter switched in (to attenuate the dc component and thereby protect our speakers), the output was clean, uncoloured, undistorted and without any significant trace of hum or noise. That is, noise from the electronic side of the amplifier

as opposed to the mechanical side.

What we soon found was that with large power dissipation into the load, the cooling fan cycled into operation and added a new unwanted spectrum of noise that the manufacturer's electronic specification tacitly ignores. With a rock band playing and sound pressure levels in the range 90 to 120 dB, this would not matter but in quiet listening rooms of a residence the fan noise level is rather disturbing. When we reduced the power levels down to something less than 25 W RMS this problem disappeared and the unit behaved in much the same way as any other amplifier.

We played a series of excerpts from the I.E.C. TC29 test tapes and direct cut records where the transient signals have dynamic ranges exceeding 60 dB. Under these conditions, the amplifier provided faultlessly clean output because we were unable to overload the system. Under normal listening conditions we were unable to activate the protection circuit although we are satisfied that our objective testing shows that this works exceedingly well.

Summary

The Crown PSA-2 self-analysing amplifier is an unusually well built unit. Its protection circuit, whilst not faultless, is certainly significantly better than any we have previously seen. With a dc to 73 kHz bandwidth, it would be equally suitable for use as a servo amplifier in laboratory studies, as a professional amplifier in a disco or at a rock concert. With the quality of its construction and flexibility of its input circuitry it would be hard to beat as an all-purpose amplifier for the professional — or even the well heeled amateur.

THE CROWN MODEL PSA-2 PROFESSIONAL SELF-ANALYSING AMPLIFIER

Dimensions: 480mm wide x 190mm high x 430mm deep, designed for 19" rack mounting.
Weight: 25.8kg Price: $2250
Manufactured by Crown International, Indiana, U.S.A.

Our Ref: E35

Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF

CROWN PSA-2 AMPLIFIER (S.N. 10507)

FREQUENCY RESPONSE:
(-3dB re 1 Watt, 0.5V Input to Auxiliary)

Direct Input
Left: DC to 74kHz
Right: DC to 73kHz

Balanced Input
Left: 2.3Hz to 53kHz
Right: 2.6Hz to 54kHz

SENSITIVITY:
(for 1 Watt in 8Ω)

	Left	Right
Direct:	42mV	42.5mV
Balanced:	10mV	9.5mV

INPUT IMPEDANCE:

	Left	Right
Direct:	20kΩ	20kΩ
Balanced:	10kΩ	10kΩ

OUTPUT IMPEDANCE: <50 milliohms (@ 1kHz)

HARMONIC DISTORTION:
(At rated power of 220 Watts into 8Ω = 41.9 Volts)

D = Direct Input
B = Balanced Input

	100Hz		1kHz		6.3kHz		
	D	B	D	B	D	B	
2nd	-76.4	-80.4	-83.1	-78.5	-87.1	-68.7	dB
3rd	-78.0	-80.6	-	-80.0	-93.2	-87.3	dB
4th	-84.8	-90.5	-90.5	-85.3	-	-78.3	dB
5th	-90.3	-94.5	-	-	-	-	dB
THD	*0.02%*	*0.014%*	*0.008%*	*0.016%*	*0.005%*	*0.039%*	

HARMONIC DISTORTION:
(At 1 Watt into 8Ω)

D = Direct Input
B = Balanced Input

	100Hz		1kHz		6.3kHz		
	D	B	D	B	D	B	
2nd	-75.3	-77.6	-	-87.1	-82.9	-82.3	dB
3rd	-78.2	-77.0	-87.4	-91.6	-85.5	-79.0	dB
4th	-85.0	-85.8	-	-91.9	-85.1	-82.7	dB
5th	-89.5	-	-	-	-	-	dB
THD	*0.022%*	*0.02%*	*0.004%*	*0.006%*	*0.01%*	*0.015%*	

TRANSIENT INTERMODULATION DISTORTION:
(3.15kHz square wave plus 15kHz sine wave, 4:1 ratio - DIM 30)

Direct input protection triggers at 0.5 Sine Wave equivalent P/P output (appears to be voltage function as occurs at same voltage level irrespective of load)

NOISE & HUM LEVELS:
(re 1 Watt into 8Ω)
(with volume control set for 1 Watt output with 0.5V input)

Direct:	-75dB(Lin)	-90dB(A)
Balanced:	-82dB(Lin)	-90dB(A)

MAXIMUM OUTPUT POWER AT CLIPPING POINT:
(IHF-A-202) 150V p-p
(20mS burst repeated at 500mS intervals) = 352 Watts
∴ Dynamic Headroom = 2.0dB (re 220 Watts)

28.11.1979

DREGS

NATIONAL PANASONIC had a stand at a recent trade exhibition for video products held in Wembley, UK. Their two prize products — and proud of them they were, too — were a video surveillance system (in various models) and a multistandard video recorder. The latter machine is not only a fascinating instrument, but useful too. It will play both American (NTSC) and European (PAL) pre-recorded video tapes.

Now where would there be a market for such a machine (expensive, too!)? North Africa. Saudi Arabia, to be precise. Caught in a mix of both American and European cultural influences, they are also caught in a mixture of American and European technological influences. There's also plenty of money. Hence the opportunity to market a multi-standard video recorder. No flys on National.

There also happens to be a roaring trade in video tapes in Saudi Arabia, principally in sports programmes and what are generally described, rather coyly, in Western circles, as "skin flicks".

Now, National — being sensitive to their refined surroundings — weren't demonstrating the machine with salacious tapes (well not that we heard, anyway). Nevertheless, the temptation of it's possibilities obviously proved too much for one wily young Turk . . er, um . . Arab (maybe it was one of the Britons . . . somebody, anyway).

One afternoon, the bulky merchandise vanished. Gone. Untraceable.

The National Panasonic reps manning the stand had little to say on the matter. Undoubtedly their faces were looking rather as if someone had severely maladjusted the hue control.

The (now missing) equipment had been on display in full view of their surveillance equipment.

Words are not inanimate objects

They play tricks on you.

Your verboplethoratic editor is convinced that certain words are destined for a hyperactive life of their own making.

Take the word "Skylab", for example. It's a proper noun, but you won't find it in the Shorter Oxford, let alone the Concise Oxford.

It happens to be an 'invented' word. History may record that it commenced life as an adjective. History may also record that it remained in the language as an adjective — "doing a Skylab", has been heard around already, usually in reference to some spectacular personal disaster.

And talking of disasters, Skylab almost caused a disaster to our October cover. Just take a quick peek at the issue. Right, Spacelab featured on the cover.

When the cover artwork was being made up, all was prepared and checked ready to send to the printers. In due course, the printers returned a 'proof' of the cover. Several minor changes were necessary and the proof was returned with corrections. When the second proof came back, all seemed in order. Just as it was to be "OKd" for printing somebody spotted the word "SKYLAB" on the front cover . . . wasn't the feature article about Spacelab?

It sure was.

See what I mean about words not being inanimate objects?

That little word 'Skylab' had crept onto the cover totally unnoticed, despite the cover artwork and proofs being seen twice by about six people.

A hasty check of all the other copy associated with the feature revealed no further evidence of the wrong word — it was Spacelab all the way.

Gaaahhhgh!!

REAL HI-FI

AND IT'S ALL IN OUR COLOUR CATALOGUE

The truth is, JVC have always produced real hi-fi components and we believe this current range represents JVC's finest range ever. Here are some real innovations and performance features to whet your appetite:— Quartz locked turntables with uncanny accuracy; Receivers/Amplifiers, some with built-in SEA Graphic Equaliser and DC, class A/B amplification; Cassette deck with JVC automatic computerised tape tuning; Computer designed speaker systems; Separate but matching JVC components designed to compliment one another, perfectly. And all this real hi-fi know-how is yours ...merely for the asking.

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the right choice

TECHNICS AMPLIFIERS MEET THEIR MATCH... TECHNICS TUNERS.

With the same clean, attractive styling and performance standards found throughout the range of Technics amplifiers, Technics tuners are the perfect companion.

Shown above is the SU-8044 integrated DC amplifier and ST-8044 tuner. The amplifier delivers 38 watts per channel output — plenty of power for dynamic sound.

Technics renowned waveform fidelity — the accurate reproduction of musical waveforms — has been achieved by eliminating coupling capacitors. The result is distortion-free amplification over a wide and flat frequency range with total harmonic distortion a mere 0.02%.

On the SU-8044 model highly accurate, easy-to-read FL (fluorescent) meters replace conventional needle-type meters for peak power indication.

The matching ST-8044 AM/FM Stereo tuner features five LED's to indicate signal strength in a linear progression. When all are lit then the best possible reception has been achieved. You are then able to utilise the active servo lock to eliminate frequency drift.

You can write to Technics Advisory Service for further facts and figures but the real test is listening . . . at your nearest Technics dealer.

For a National Technics catalogue, please write to:
Technics Advisory Service, P.O. Box 278, Kensington, N.S.W. 2033

National Technics hi-fi

T79.28